CROSS-STATE ELECTRICITY LOAD REDUCTIONS UNDER EPA'S PROPOSED CLEAN POWER PLAN

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States will likely invest in energy efficiency and renewable energy in order to comply with the Clean Power Plan. Yet the flow of power between states creates accounting problems since the actions of power importers can affect those of exporters. EPA is likely to require states to validate the environmental integrity of their plans by ensuring that power importing and exporting states do not take credit for the same emissions reductions. This brief reviews current EPA guidance on accounting for this "interstate effect," finding that no method is sufficiently precise in the absence of a regional approach that fully subsumes all interstate dynamics. This suggests that power-importing states choosing to comply in isolation will have difficulties in reaping the benefits of programs that they put in place, which could lead to under-investment in energy efficiency in particular. It further suggests that states have strong reasons to work together on multi-state plans.

OVERVIEW

The U.S. Environmental Protection Agency (EPA) proposed state-specific emission rate goals for existing power plants in its recent "Clean Power Plan." These goals are based on, among other things, increased deployment of end-use energy efficiency and renewable energy in order to decrease demand for fossil fuels. Yet due to the interconnected nature of the electricity grid, some of the fossil generation reductions associated with policies implemented by the "program state" may occur in neighboring "generator states." This is known as the "interstate effect."

Treatment of the interstate effect in state plans implementing the Clean Power Plan could profoundly change the compliance strategy for states, which may only be willing to invest in load-reducing policies if their reductions can be counted toward compliance goals regardless of where they physically occur. Additionally, the integrity of the rule could be compromised by double-counting reductions in both the program and generator states. This brief explores how a state might account for these savings depending on its choice of compliance pathway. It finds that states complying individually will be unable to take credit for out-of-state generation or emission reductions from energy efficiency. This suggests states have strong reasons to work together on multi-state compliance plans.

BACKGROUND

Section 111(d) of the Clean Air Act requires EPA to establish guidelines for the regulation of carbon dioxide (CO_2) emissions from existing sources, in this case power plants, which collectively account for almost 40 percent of the United States' current domestic CO_2 emissions. The Clean Power Plan was proposed on June 2, 2014, and is projected to achieve a 30 percent cut in power sector emissions from 2005 levels. The proposal contains four "building blocks" which were used to construct state emission rate goals for the year 2030:[1]

1. Make coal power plants more efficient.
2. Use low-emitting natural gas combined cycle plants more where excess capacity is available.
3. Use more zero- and low-emitting power sources such as renewable energy (RE)[2] and nuclear.
4. Reduce electricity demand through energy efficiency (EE).

While the first two blocks are designed to decrease the carbon intensity of current fossil fuel generation, the third and fourth blocks seek to lower demand for and displace this generation. The proposed rule covers most fossil fuel sources over 25 megawatts (MW) in capacity, and excludes most existing nuclear as well as hydroelectric capacity.

THE INTERSTATE EFFECT

The interconnected nature of the electricity grid means that one state's EE/RE program may reduce output and emissions from electric generating units (EGUs) in neighboring states. When a state decreases its demand for fossil electricity via an EE/RE policy, one or more fossil EGUs respond by producing less so that system supply and demand remain precisely balanced. As a simple example, consider two hypothetical neighboring states, State A and State B. Suppose State A (the program state) decreases its annual demand, also called load, by 1,000 megawatt-hours (MWh) due to an EE program. If it imports 10 percent of its electricity consumption from State B (the generator state), State B will produce 100 MWh fewer than it would have otherwise over the course of the year. This avoided generation in State B represents emission savings.

Equity principles might suggest State A should get full credit for these savings because the savings derive from their efforts alone, and State B should get none of the credit. That is, State B would get no credit for the reductions that took place within its borders that were the result of EE policies put in place by State A. EPA affirmed this with regard to RE programs, proposing that "Consistent with existing state RPS policies, a state could take into account all of the CO_2 emission reductions from renewable energy programs and measures implemented by the state, whether they occur in the state and/or in other states."[3] In contrast, EPA proposed for EE that "A state may take into account in its plan **only** those CO_2 emission reductions occurring in the state that result from demand-side energy efficiency programs and measures implemented in the state" (emphasis added).[4]

EPA appears to treat EE and RE differently due to the preponderance of state RPS policies which allow for crediting of out-of-state RE generation and/or the trading and tracking of Renewable Energy Certificates (RECs) between states. So far, EPA has not specified the accounting methods by which these principles may be implemented. Nevertheless, establishing a similar certificate-based system for denoting the energy savings from EE programs could potentially be one way to address the double-counting problem. As with RECs, this certificate system would require shared calculation metrics and verification methods as well as a high degree of transparency.

Under mass-based compliance systems[5], both states could account for the savings by measuring and summing the emissions from all their respective EGUs. That is, State A would report the emissions savings associated with 900 MWh of reduced in-state demand, while State B would report the emissions savings associated with 100 MWh of reduced in-state generation. However, if State A chose to account for the full emissions savings of its policy, including those that were realized in State B, this additional tonnage could conceivably also be claimed by State B and thus double-counted.

Under rate-based systems and one possible accounting method in the proposal, State A would account for the emission savings by adding the 1,000 MWh of avoided generation to the denominator of its emission rate, while State B might also claim the reductions in emissions caused by its generators producing 100 fewer MWh (see **Equation 1**).[6] Note that State B's emission rate would likely change as well, because generation resources are not evenly displaced (see *Measuring EE/RE savings*). Its rate could increase or decrease depending on the carbon intensity of the displaced resources described in **Equation 1**.

EQUATION 1: Example State A and B adjusted emission rates following a 1,000 MWh load decrease in State A

$$\textbf{State A: } \frac{\text{lbs CO2}}{\text{MWh+1000}} \quad \textbf{State B: } \frac{\text{reduced lbs CO2}}{\text{MWh-100}}$$

State A adds the 1,000 MWh of savings from EE to the denominator of its emission rate. State B decreases its denominator to account for its avoided power exports, and adjusts its numerator to reflect the associated avoided emissions.

The problem of the interstate effect is two-fold: quantifying savings in a state that transpire due to efforts taken in a different state, and ensuring that they are not double-counted. Thus far no means of both awarding State A full credit and preventing State B from double-counting the savings has been put forward that does not involve some sort of collaboration or joint accounting system. States that import or export a significant portion of their electricity (see **Table 1**) are most affected and could create tension in their region by attempting to secure as much credit for themselves as possible.[7]

Yet virtually all states will be affected to some degree, and many will depend on EE/RE programs to achieve compliance.[8] Therefore, states have a vested interest in ensuring their abatement efforts are recognized to the fullest extent possible. Note that the following analysis assumes a priori that the avoided generation from EE and RE programs can be accurately measured. In practice, however, this can be challenging, especially for EE due to the diversity and complexity of available programs.[9]

STATE PLAN DESIGN

Using EPA's Clean Power Plan as guidance, each state will be required to develop and submit its own state plan to achieve its target emission rate. According to EPA's proposed guidelines, there are two chief analytical components to a satisfactory state plan.[10] The state must first demonstrate that its projected emission performance is equal to or better than its target. Second, the state must describe how it intends to measure and verify its progress and ultimately demonstrate its compliance, including how it will use corrective measures if it appears to be falling short of its goals.

As the following sections will demonstrate, planning EE/RE programs is uniquely challenging even without the wrinkle of the interstate effect. Modeling anything over a decade into the future is inherently fraught with

TABLE 1: Top Ten Electricity Importing and Exporting States, 2012

State	Imports (% of consumption)
Maryland	43%
Idaho	39%
Massachusetts	39%
Virginia	39%
Delaware	30%
Minnesota	29%
California	28%
Tennessee	25%
Ohio	21%
New Jersey	19%

State	Exports (% of consumption)
Wyoming	63%
North Dakota	56%
West Virginia	54%
Montana	46%
Alabama	39%
New Hampshire	39%
New Mexico	31%
Pennsylvania	30%
Arizona	26%
Arkansas	22%

Importer states are defined as those whose net consumption exceeds net generation, and exporter states are defined as those whose net generation exceeds consumption. In 2012, 14 states imported over 10% of their power from other states.

Source: Net generation data from Table 3.6. Net generation by state by sector in U.S. Energy Information Administration, Electric Power Annual (Washington, DC: U.S. Energy Information Administration, 2013), http://www.eia.gov/electricity/annual. Consumption data from U.S. Energy Information Administration, "Table F21: Electricity Consumption Estimates, 2012," last accessed November 24, 2014, http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_fuel/html/fuel_use_es.html&sid=AL. Generation adjusted downward by 7.51% to reflect average line losses.

uncertainty. In addition, a retrospective, or "look-back," analysis of the savings incurred by an EE/RE program requires a conception of how much energy would have been consumed without the program. States seeking to incorporate corrections for the interstate effect in these analyses will encounter further difficulties. The following section outlines ways of quantifying the savings from EE/RE programs, including those realized in other states. This brief will then explore multi-state and individual state compliance pathways, and how states might apply different measurement techniques to address the interstate effect and avoid double-counting by working together.

MEASURING EE/RE SAVINGS

The primary objective in estimating the savings from an EE/RE program is to identify the EGUs from which generation was or will be displaced (depending if the analysis is an *ex post* demonstration or an *ex ante* projection). Different EGUs have different emission rates, so in order to estimate the tons or pounds of CO_2 saved by its policy the state must identify which EGUs produced less power and fewer emissions because of the policy, then compare observed energy use (measured in MWh) and emissions (measured in tons of CO_2) to the energy and CO_2 that would have otherwise occurred. The quantity of CO_2 saved would then be either reflected in a state's total mass emissions, or applied directly to the emission rates of affected EGUs to adjust the state's overall emission rate. All quantification methods vary by their analytical sophistication, their utility in an individual versus multistate compliance scenario, and their ability to accurately project future emission performance and capture the interstate effect.

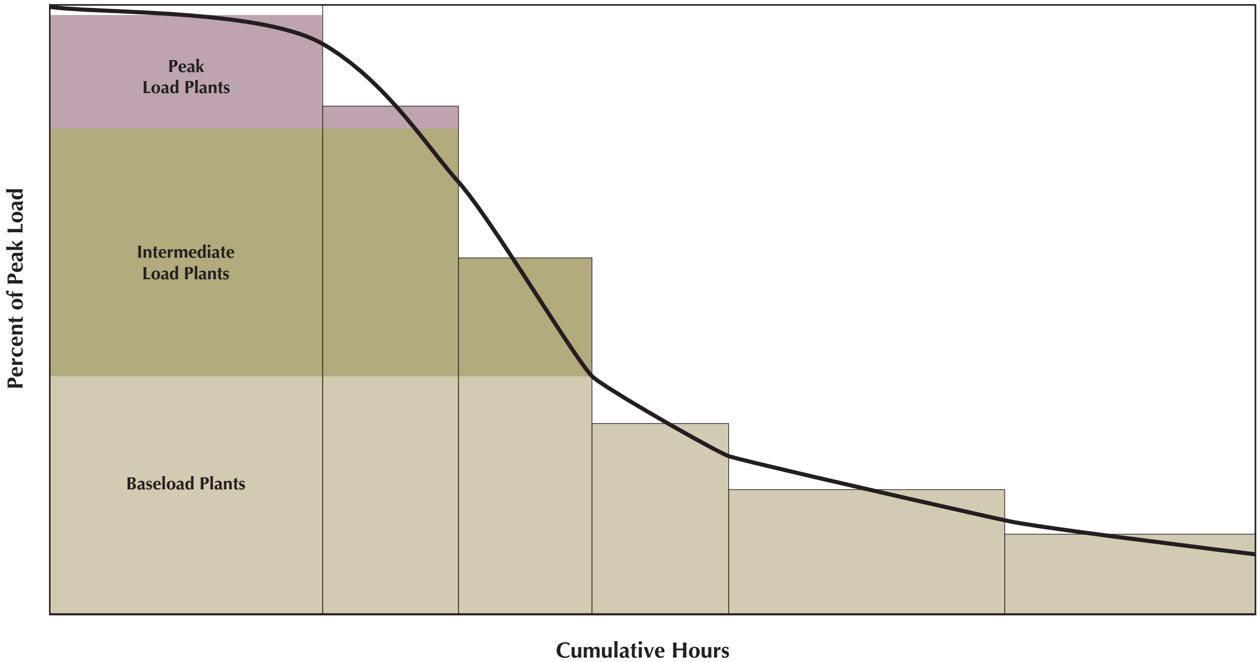
EGRID NON-BASELOAD/CAPACITY FACTOR

The most basic way to estimate avoided emissions from EE/RE programs is to multiply the saved megawatt-hours by the appropriate avoided emission rate factor, which describes either the average or marginal carbon intensity of the local electricity grid. Annual average avoided emission rates assume that all generation resources in a grid region reduce output proportionately when regional load decreases. This means that in a region with a generation mix of 60 percent natural gas and 40 percent coal, 60 percent of the generation reductions following a load decrease would be assumed to come from natural gas EGUs and 40 percent would be assumed to come from coal EGUs.

In contrast, a marginal emission rate assumes that only certain kinds of EGUs will be displaced following a regional load reduction. This assumption is more representative of how generation resources are sequentially deployed (or dispatched) to meet demand in practice. Least-cost power generation resources are typically dispatched before more expensive ones on a variable cost basis, meaning plants with low operating costs (including fuel) are prioritized over costlier ones to run for a greater number of total hours per year. This ordering minimizes overall cost while meeting anticipated load. Thus RE/EE programs typically reduce generation from the highest-cost generation resource that otherwise would have been dispatched. Determining the marginal unit of generation reduced by an RE/EE program includes technical considerations as well since the generation from some EGUs, such as natural gas combined cycle plants, can more easily be adjusted than others, such as coal plants.

Power generation resources are broadly categorized as baseload, intermediate, or peak, depending on how often they are dispatched to meet system demand. As **Figure 1** shows, cheaper "baseload" sources like coal or nuclear run year-round, while non-baseload EGUs are more expensive, run less often, and are thus more likely to be displaced by EE/RE programs. These non-baseload sources may be natural gas and renewables at the intermediate level, and less efficient and more carbon-intensive combustion turbines at the peak level. EE measures typically shave peak demand, but large-scale RE deployment may result in deeper load reductions down to the intermediate level. Note that because renewables are generally the cheapest option on a variable cost basis (when available), they are unlikely to be displaced by another state's load reduction program. Furthermore, they are seldom used as "peaker" plants because they cannot be reliably dispatched during peak demand periods due to their inherent intermittency.

FIGURE 1: Sample Load Duration Curve



Energy efficiency and renewables typically displace generation from peak load resources, which comprise the top portion of the curve.

Source: Community for Energy, Environment and Development, "Dispatching Processes on a Load Curve," last accessed November 24, 2014, http://energycommunity.org/WebHelpPro/Transformation/Dispatching_Processes_on_a_Load_Curve.htm.

The avoided emissions from these non-baseload sources, whatever their composition, may be roughly estimated via the non-baseload emission factors found in EPA's Emissions & Generation Resource Integrated Database (eGRID). eGRID contains operational data for almost all electricity generated in the United States, including generation, total annual emissions, emission rates, and more.[11] The state would multiply its estimated avoided generation or sales by the target state's average non-baseload rate to determine the approximate CO_2 savings:

In the case of a state that imports electricity from one or more neighbors, the state would need to know the proportion of its imports that came from each of its neighbors and estimate a weighted average emission rate for non-baseload generation, where the weights correspond to the proportion imported from each neighboring state. If these proportions are unknown, the EE/RE program's total avoided generation would also be unknown and this approach has limited utility.

A similar basic estimation method is the capacity factor emission rates approach. A power plant's capacity factor is the ratio of actual electricity produced to the maximum amount that could have been produced under perfect operating conditions. This method assumes that plants with lower capacity factors (i.e. plants that run less often) are more likely to be displaced by EE/RE programs.[12] Using seasonal capacity factors from eGRID, a state could determine which EGUs will be most likely on the margin and displaced by EE/RE programs in a given season. It would then multiply its estimated avoided generation or sales by the emission factors of

EQUATION 2: Sample eGRID calculation of the avoided emissions associated with EE/RE

$$\text{Avoided generation or sales in State B (MWh)} \times \text{State B's non baseload rate } \left(\frac{\text{lbs}}{\text{MWh}}\right)$$

The emissions savings are calculated by multiplying the energy savings from EE (in megawatt-hours) by the state's non-baseload emission rate (in pounds per megawatt-hour). Non-baseload rates reflect the fact that EE/RE programs usually do not displace baseload generation.

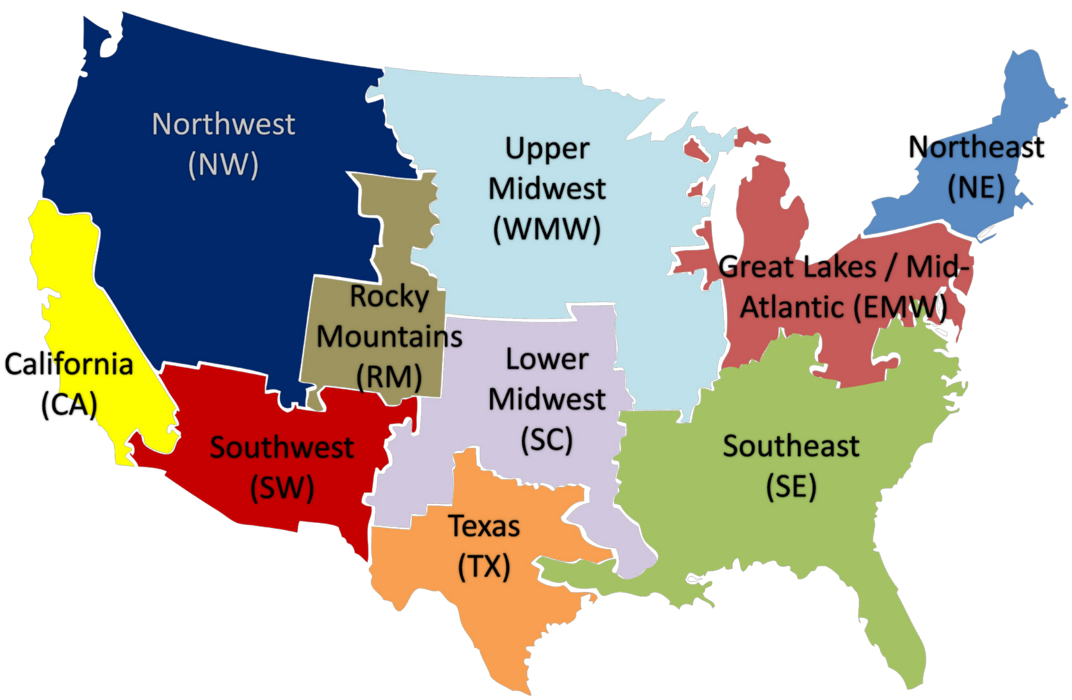
these marginal EGUs to arrive at the emission savings. Again, this approach assumes the approximate out-of-state generation savings can be identified. In addition, it may be inappropriate in certain instances in which plants with higher capacity factors are nonetheless on the margin due their higher variable cost.

While both of these methods are adequate for roughly estimating EE/RE savings across state borders, neither of them prevent the importing state's neighbors from simply noting that their own generators were producing less power and emissions and crediting the reductions against their own state target. In addition, EPA notes that both approaches "rely on historical data and patterns of dispatch, which may not represent future patterns of dispatch" and may thus be inadequate for *ex ante* analysis.[13] Finally, it is questionable whether these basic approaches would be sufficiently analytically rigorous to produce an approvable state plan. With regard to state implementation plans for other Clean Air Act programs such as National Ambient Air Quality Standards, EPA considers the eGRID approach as only a qualitative, preliminary screening tool to be used to justify a more sophisticated analysis of savings from EE.[14] Given the availability and greater sophistication of modeling tools, it is unlikely this approach would be acceptable. In addition, eGRID data is currently only published by EPA on an annual basis, and with a three-to-four year lag. In order to provide states with a more accurate snapshot of the interstate emissions they are displacing, EPA would have to update its database on a much more frequent basis.

HISTORICAL HOURLY EMISSION RATES

A more sophisticated method of quantifying EE/RE emissions benefits is to use historical data to statistically predict how a multi-state fleet of EGUs would respond

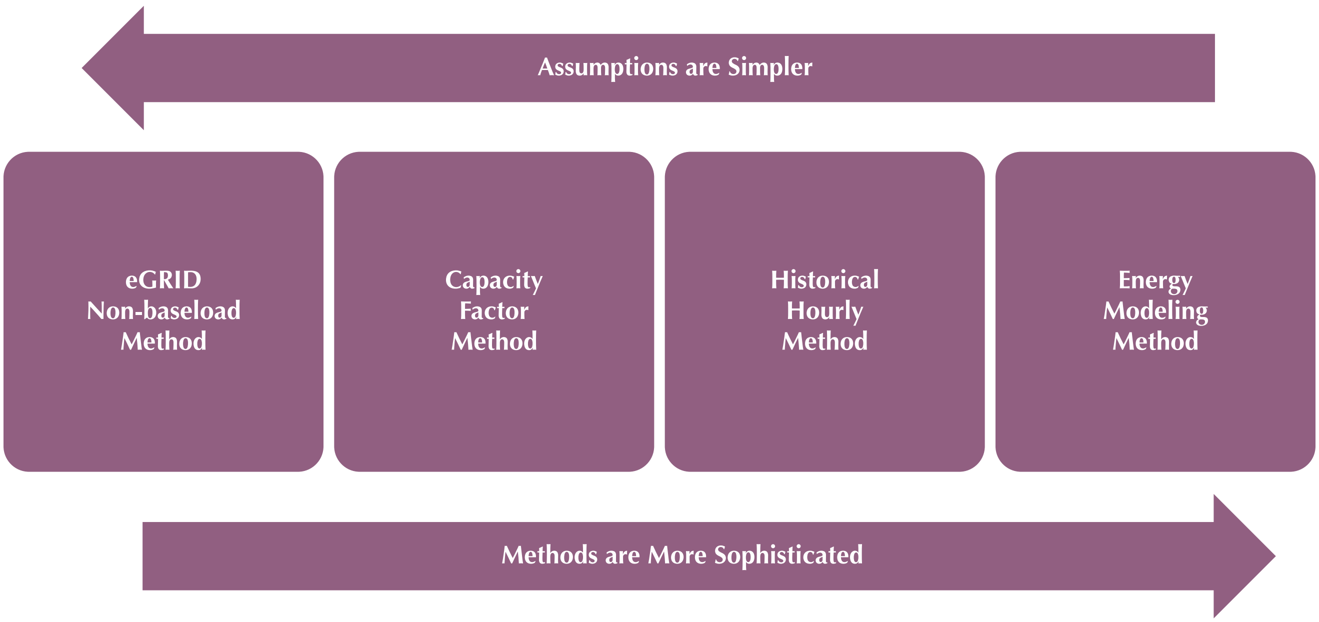
FIGURE 2: AVERT Partitions the Contiguous United States into the Following Electrical Grid Regions



The model estimates the effects of an EE/RE program on this regional basis. Consequently, the model does not estimate generation or emissions savings on a state-by-state basis.

Source: Climate Protection Partnerships Division, "AVoided Emissions and geneRation Tool" (Washington, DC: U.S. Environmental Protection Agency, 2014), http://epa.gov/statelocalclimate/documents/pdf/AVERT%20User%20Manual_02-13-2014%20Final_508.pdf.

FIGURE 3: Methods for Measuring Savings From EE/RE, Ranging from Using Average Grid Emission Factors (eGRID) to Power Flows



While eGRID requires the fewest assumptions to implement, it cannot distinguish the interstate effect. While the sophisticated methods produce more precise estimates of the savings from EE/RE, they do not address the double-counting problem.

Source: U.S. Environmental Protection Agency Climate Protection Partnerships Division, "AVoided Emissions and geneRation Tool" (Washington, DC: U.S. Environmental Protection Agency, 2014), p. 3, http://epa.gov/statelocalclimate/documents/pdf/AVERT%20User%20Manual_02-13-2014%20Final_508.pdf.

to a regional load reduction. EPA developed the AVERT (Avoided Emissions and Generation Tool) model for this purpose. With AVERT, the user inputs the anticipated load reduction from an EE/RE program and obtains an estimate of the corresponding emissions savings with the specified region. These regions are broad power pools (**Figure 2**).

AVERT is a region-based planning tool and therefore would be most useful to a group of states jointly demonstrating performance (see *Multistate Compliance*). Its scope is sufficiently broad to capture most cross-border dynamics within any of its pre-defined regions, but its results will be most meaningful if all states located in the given region, e.g. all states in the green Southeast region, participate in a multi-state plan and pursue a cumulative target. This is because AVERT lacks the resolution to distribute reductions among the states in a simulated region. A smaller group of states could theoretically be simulated by paring down the underlying regional data sets, but at some point the results, which are premised on coordination across the larger power pool, would no longer be representative of the resources available within a sub-regions. Although AVERT does not allow for directed load reductions within a region, an individual state could use it to account for broad interstate effects when simulating EE/RE savings. However, these savings would remain subject to double-counting by the other states in the region, unlike in the case of a regional approach in which emissions and energy use are aggregated across state lines and interstate effects thereby avoided entirely, at least within the region.

A more serious drawback of AVERT is its limited ability to predict future power generation and emissions patterns based on historical data alone. Although AVERT includes the option to manually add or retire EGUs, it is not designed to make projections for how this affects regional dispatch decisions more than five years into the future. This is because changes in fuel prices, control technologies and other factors are assumed to be held constant but in fact are so unpredictable that they may affect the power pool as well.[15] Since it is not equipped to project EGU emission performance through

2030, AVERT is likely best incorporated into a state plan as a means of monitoring progress during the compliance period. However, an energy modeling or similar approach would still be needed to project into the future.

ENERGY MODELS

As an alternative to the relatively simple approaches explained above, a state or group of states could use complex energy models to understand what generation was or will be displaced by its EE/RE programs. The temporal and spatial scope of these models varies, but they all can generally incorporate or even predict changes in dispatch and capacity.[16] Energy modeling can provide a detailed estimate of savings from EE/RE programs, but the results are highly sensitive to exogenous assumptions governing the actions of neighboring states as well as the reference state.

For example, a model that underestimates an adjacent state's eventual shift away from coal to natural gas would overestimate the magnitude of reductions from EE and RE initiatives. As a result, the interstate effect of such initiatives will likewise be over-estimated, since the EGUs that are eventually displaced are cleaner than otherwise expected. Indeed, EPA is considering whether it will provide "default modeling assumptions, or data sources for key assumptions" to help states with their modeling efforts.[17] These could include future fuel prices, engineering improvements, load growth forecasts, etc. The most realistic assumptions, however, will ultimately come out of discussions and collaborations between states. In light of the considerable computational overhead associated with modeling and the poorer reliability of single-state models, this principle gives states incentive to follow a multi-state pathway.

ASSESSMENT OF INTERSTATE EFFECTS BY EPA

EPA has also stated that it could "assess the emissions performance of affected EGUs on a regional basis, considering the measures contained in the group of state plans for a respective grid region."[18] Essentially, EPA could correct for interstate effects within a region when reviewing the submitted individual plans of its respective states. Some states might welcome the opportunity to shift this analytical burden to EPA, if they are confident that they would ultimately be more accurately compensated for their EE/RE efforts.

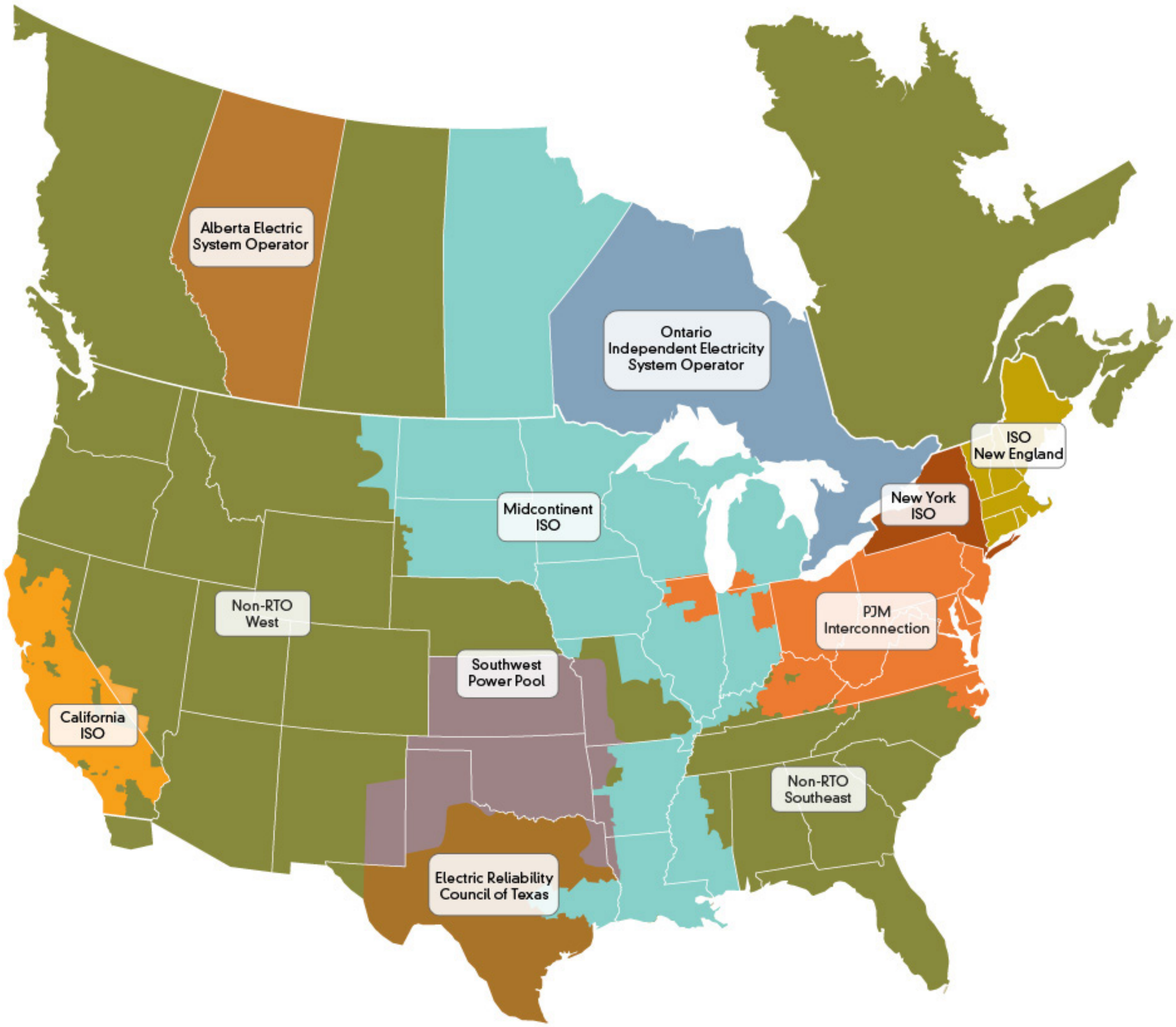
MULTISTATE COMPLIANCE

States will be able to choose to comply with 111(d) as either an individual entity or as part of a multi-state agreement. As this section will show, a multi-state compliance program is better suited to capturing the dynamics of cross-border electricity flows and can make accounting for interstate effects easier or even unnecessary, depending on how states choose to group themselves.[19] To see this, consider the earlier example of neighboring states A and B. If both states work together to achieve a single cumulative target, the distribution of individual abatement efforts is irrelevant for federal compliance purposes (though critical to a successful partnership). Alternatively, if the states choose to file separate plans they will still benefit from collaborating to distribute reductions among themselves in a fair and mutually satisfactory manner. The following sections explore these considerations in more detail.

REGIONAL DEMONSTRATIONS

Under a regional demonstration approach, states would jointly assess interstate effects across their collective EGU fleet and file a single plan with a cumulative emissions target, rather than distributing emission reduction burdens among themselves. In theory, this could be accomplished by defining the region as the service territory of the local Regional Transmission Organization (RTO) or Independent System Operator (ISO).[20] RTOs and ISOs are government-regulated entities that operate regional electricity grids by setting locational prices to encourage production efficiencies and ensuring open access to transmission networks.[21] These bodies oversee power dispatch and routinely use energy models to meet anticipated load growth and maintain grid reliability. They are thus amply suited to project savings from EE/RE programs and apportion them among states to avoid double-counting.

FIGURE 4: Map of RTO/ISO territories



Interstate effects within each of these territories are expected to be negligible since all power flows are coordinated by a centralized grid operator.

Source: Sustainable FERC Project, "ISO RTO Operating Regions", last visited, November 24, 2014, http://sustainableferc.org/wp-content/uploads/2013/10/ISO-RTO-Operating-Regions.jpg.

As **Figure 4** shows, roughly three-quarters of all states participate at least partially in an ISO/RTO. In many cases, it could make sense for states in the same ISO/RTO to work together, since "attribution of emission reductions from demand-side EE measures would not be necessary."[22] Otherwise, depending on what level of precision EPA requires, accounting for interstate effects would become staggeringly complex in light of the numerous routine power flows back and forth across state borders. Where a state is a member of multiple ISO/RTOs, it could presumably group its generators to minimize confusion, or push the neighboring networks to adopt similar compliance strategies.[23] The grid operator would also have to work with peripheral states to address any interstate effects between them and the ISO/RTO, though these effects would presumably be minimal since ISO/RTOs are fairly self-contained electrical systems by construction.

States that do not currently participate in an ISO/RTO may also find it advantageous to collaborate. The Regional Greenhouse Gas Initiative emissions trading program in New England is a prime example of a successful alternative grouping. Neither are potential collaborators limited to working under a carbon trading regime. A group of states with similar energy mixes, resources, or planning frameworks could also collaborate on a regional plan. Of course, any boundaries drawn in state or regional plans will still result in some amount of interstate or interregional electricity flows. Following ISO/RTO lines could simplify accounting and cooperation among regions, but it would not eliminate the interstate effect.

JOINT DEMONSTRATIONS WITH COOPERATIVE ACCOUNTING

A group of states may instead choose to file individual plans but work together to distribute the regional emission reductions from their EE/RE programs among themselves. According to EPA, participating states would adjust their EGU fleet emissions performance based on some agreed-upon formula, so that "a 'credit' for out-of-state emission effects in one state would be complemented by a 'debit' for such effects in another state."[24] That is, if EGUs in State A are credited for an EE program that reduces emissions in State B, the affected EGUs in State B would be debited an equivalent amount of emissions. This approach would prevent double-counting since the two states would be unable to claim the same credit. Unlike the regional demonstration approach, however, the states would need to know which specific EGUs were affected in this scenario. This information can only be produced by strong collaborative energy modeling.

States could engage in a variant of the cooperative accounting approach described above via a trading market for credits based on reductions from RE and demand-side EE actions. EE/RE programs that meet certain requirements would be allowed to generate credits, denoted in avoided tons of CO_2, within the covered region.[25] Affected EGUs would then purchase and apply these credits to their emission rates according to an agreed-upon formula or other administrative adjustment, and their prices would vary based on EGU marginal abatement costs and other economic conditions.[26] A tradable credit market would ensure that all participating states have access to the most cost-effective abatement opportunities available in the region. For example, it would allow states with limited compliance flexibility to capitalize on another state's surplus natural gas reserves.

CHALLENGES

First-Mover Advantage

One potential issue with a regional approach is that returns on EE/RE investments could diminish as more participants become involved. This is because EE/RE programs tend to displace marginal EGUs, which tend to have higher emission rates (see *Measuring EE/RE savings*). As more of these carbon-intensive EGUs get displaced by EE/RE policies, the regional power dispatch becomes cleaner and the next megawatt of RE or EE saves fewer marginal emissions. Thus each member of a group of states in a region might seek to implement their programs first in order to realize the most savings per dollar, effectively discounting the subsequent efforts of others. This incentive is likely stronger in regions with immature or non-existent EE/RE portfolios (e.g. the Southeast) than in regions with more mature ones (e.g. California and New England).[27]

Barriers to Collaboration

A state may prefer an individual compliance pathway to a multi-state one for a variety of reasons. It may not view the state plan components of its neighbors as entirely credible, fearing that a collaborative compliance effort would be jeopardized by one or more partner states failing to satisfactorily implement EE/RE programs. Alternatively, a state may determine that it will be more feasible to implement a rate-based standard and may not wish to participate in a regional coalition that is pursuing a mass-based target. States may also be concerned that the compliance timeframe is simply too short to design and execute an effective multi-state program, though EPA has proposed a one-year extension for this pathway (in addition to the one-year extension available to states on an individual pathway).[28]

State collaboration requires both technical and political cohesion, and some states may be unwilling to work together due to political or economic conflicts. Discordance between states can be caused by differences in resource and generation mix. For example, export-heavy states will see their own EGU fleet emissions drop as a result of their neighbors' EE programs. It might be easier for these exporting states to claim some of this decrease for their own compliance purposes if they avoid collaborating with neighbors and the accompanying auditing process. Conversely, if a state began exporting power produced from natural gas and reported a lower emission rate, the state consuming the exported power might also claim the associated emission savings if it had shut down one of its own coal plants to accommodate this imported (and presumably cheaper) power. This purposeful double-counting would be more difficult to accomplish when states are actively collaborating.

INDIVIDUAL COMPLIANCE

States that choose an individual compliance pathway will also have to choose from any of the above tools for measuring EE/RE savings. As previously noted, EPA proposed that an individual state could get credit for out-of-state savings from RE but not from EE, unless the state could demonstrate that its out-of-state EE emission reductions will not be double-counted. Note that a state could forego its potential claim to out-of-state reductions and calculate its emission rate based only on the CO_2 emissions at its in-state EGUs. This approach is not very compelling to an import-heavy state since it effectively discounts the value of its EE/RE program; hence, such states should be expected to seek ways to preclude double-counting in order to receive full credit for their abatement efforts.

An individual state trying to account for the interstate effect (i.e. State A) will encounter two challenges along the way. First, it will struggle to reasonably project the potential out-of-state savings from its program without also knowing State B's future energy mix (in order to conceptualize the emissions it will be displacing). Second, it will be hard tasked to ensure State B does not later double-count these reductions as its own. The latter challenge is made even more difficult in the absence of active collaboration and/or participation in a regional approach.

This brief offers one potential solution to the quandary. EPA gained extensive familiarity with state energy profiles over the course of its rulemaking. It could use this experience to generate a reference list of default assumptions which individual states could use when projecting their EE/RE savings (including the interstate effect) to satisfy the *ex-ante* analysis component. This would include projections for everything from load growth to fuel prices. Then, EPA could broadly assess interstate effects, as described earlier, but with the use of simple import/export factors rather than complicated energy models.

For example, suppose State B discovered that its emissions in 2030 were lower than projected in its own state plan, and that the reductions were not due to fuel-switching or its own EE/RE programs. If State A was the only state that imported electricity from State B that year, it follows that the additional emission reductions in State B are attributable to the EE program in State A (assuming State B didn't significantly err in its assumptions governing parameters such as economic growth). In the more realistic case of multiple importing states, EPA would use import/export factors to roughly apportion the extra savings accordingly. That is, if State B exported 5 percent of its generation to State A and another 10 percent to State C, the additional savings witnessed in State B would be proportionately distributed among States A and C.

This method would preclude double-counting since State B would be unable to claim any additional emission reductions beyond those forecast in its plan. It may also, however, act as a perverse incentive for a non-cooperating, power exporting state to inflate its projected reductions to minimize the likelihood of later exceeding them and potentially sacrificing additional compliance credit. For example, if State B officially projected a savings of 100 tons in its state plan but internally planned to only reduce 80 tons, it could potentially still end up claiming 100 tons if it measured 20 additional tons of interstate reductions at its smokestacks. Therefore if State B had a reasonable a priori estimate of the magnitude of these interstate reductions, it could adjust its state plan projection to capture them. Finally, this method represents an additional though relatively minor administrative burden on EPA, and assumes these import/export factors are measureable quantities.

ANALYSIS OF CONSIDERATION FOR STATES

This analysis suggests states have strong and numerous reasons to work together on multi-state plans. First, interstate dynamics are exceedingly difficult to capture with precision on an individual basis, whereas they are more easily calculated and in certain cases obviated when a collaborative approach is applied. Second, absent collaboration there does not appear to be a feasible way of preventing double-counting, save for *ex post* joint assessment by EPA. Finally, less tangible benefits may accrue from collaboration, such as technology transfer and sharing of best practices.

The incentive to account for interstate effects, at least from EE, could depend on economics more than anything else. EPA stated that "Given the extremely low cost of CO_2 emission reductions achievable through demand-side energy efficiency programs, implementation of such programs is likely to reduce CO_2 emissions at reasonable cost even for a state whose own affected EGUs achieve only part of the CO_2 emission reduction benefit from the state's demand-side energy efficiency efforts."[29] Of course, interstate effects will likely be much more significant in the case of renewables due to their higher capital cost.

The Clean Power Plan will not be finalized until 2015, so the states most affected by cross-border dynamics still have time to voice their concerns and advocate for clarity on approvable accounting methodologies. Otherwise, they risk having to use an accounting system that doesn't fully take into consideration their unique interests. In the meantime, states should actively seek opportunities to collaborate with neighbors.

ENDNOTES

1 Center for Climate and Energy Solutions, "Q&A: EPA Regulation of Greenhouse Gas Emissions from Existing Power Plants," last accessed November 21, 2014, http://www.c2es.org/federal/executive/epa/q-a-regulation-greenhouse-gases-existing-power.

2 Because EPA did not include large hydroelectric generation in its building block calculations for state goals, "RE" shall refer to other renewable sources such as wind and solar in this report.

3 Ibid.

4 U.S. Environmental Protection Agency, *Technical Support Document for Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units: State Plan Considerations* (Washington, DC: U.S. Environmental Protection Agency, 2014), p. 87, http://www2.epa.gov/sites/production/files/2014-06/documents/20140602tsd-state-plan-considerations.pdf.

5 Under the proposed rule, states have the option of accounting for their carbon dioxide emissions on either a mass (tons) or rate (tons per megawatt-hour) basis. See U.S. Environmental Protection Agency, "Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units," 79 Fed. Reg. 117 (June 18, 2014).

6 Ibid.

7 This report uses "credit" in the sense of any calculation that lowers a state's emission rate and facilitates compliance within the proposed Clean Power Plan, in contrast to a system of allowances that a state authority could distribute to its own compliance entities.

8 Center for Climate and Energy Solutions, "Carbon Pollution Standards Map: Renewable Generation in the Clean Power Plan," last accessed November 21, 2014, http://www.c2es.org/federal/executive/epa/carbon-pollution-standards-renewable-energy-map.

9 Center for Climate and Energy Solutions, "Measurement, Reporting, and Verification," last accessed November 21, 2014, http://www.c2es.org/international/negotiations/measurement-reporting-and-verification.

10 For the complete list of the twelve components, see U.S. Environmental Protection Agency, "Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units."

11 U.S. Environmental Protection Agency Office of Air Quality Planning and Standards, "Appendix I: Methods for Quantifying Energy Efficiency and Renewable Energy Emission Reductions" in *Roadmap for Incorporating Energy Efficiency / Renewable Energy Policies and Programs into State and Tribal Implementation Plans* (Research Triangle Park, NC: U.S. Environmental Protection Agency, 2012), p. I-19, http://epa.gov/airquality/eere/pdfs/appendixI.pdf.

12 Ibid, I-23.

13 U.S. Environmental Protection Agency, *Technical Support Document for Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units: State Plan Considerations*, p. 27.

14 U.S. Environmental Protection Agency, *Roadmap for Incorporating Energy Efficiency / Renewable Energy Policies and Programs into State and Tribal Implementation Plans*, p. I-20.

15 U.S. Environmental Protection Agency Climate Protection Partnerships Division, "AVoided Emissions and geneRation Tool" (Washington, DC: U.S. Environmental Protection Agency, 2014), p. 10, http://epa.gov/statelocalclimate/documents/pdf/AVERT%20User%20Manual_02-13-2014%20Final_508.pdf.

16 These models include the Integrated Planning Model (IPM) which simulates the entire power sectors, as well as smaller electrical dispatch models based at the utility level.

17 U.S. Environmental Protection Agency, *Technical Support Document for Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units: Projecting EGU CO_2 Emission Performance in State Plans*, (Washington, DC: U.S. Environmental Protection Agency, 2014), p. 43, http://www2.epa.gov/sites/production/files/2014-06/documents/20140602tsd-projecting-egu-co2emission-performance.pdf.

18 U.S. Environmental Protection Agency, *Technical Support Document for Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units: State Plan Considerations*, p. 95.

19 Ken Colburn, "Tackling 111(d): Could Regional Approaches Rule?" Regulatory Assistance Project, last accessed November 21, 2014, http://www.raponline.org/featured-work/tackling-111d-could-regional-approaches-rule.

20 David Nemtzow and Omar Siddiqui, *Giving Credit Where Credit Is Due: Energy Efficiency in CO2 Emissions Trading* (Washington, DC: American Council for an Energy-Efficiency Economy, 2008), https://www.aceee.org/files/proceedings/2008/data/papers/8_555.pdf.

21 Cliff Hamal, Markets Matter: Expect a Bumpy Ride on the Road to Reduced CO2 Emissions (Chicago, IL: Navigant Consulting, 2014), http://www.navigant.com/~/media/WWW/Site/Insights/Economics/ECONMarketMattersNOCOVERTL052214.ashx.

22 U.S. Environmental Protection Agency, *Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units*, p. 34830, 34922.

23 Carrie Jenks, Christopher E. Van Atten, and Tom Curry, *Multi-State Responses to GHG Regulation Under Section 111(d) of the Clean Air Act* (Concord, MA: M.J. Bradley & Associates LLC, 2014), p. 13, http://www.mjbradley.com/sites/default/files/Multi-State%20Responses%20to%20GHG%20Regulation.pdf.

24 U.S. Environmental Protection Agency, *Technical Support Document for Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units: State Plan Considerations*, p. 93.

25 EPA has also proposed issuing credits on an avoided MWh basis, but it is unclear how this would work in practice without some way to compare the carbon content of different avoided MWh alternatives.

26 U.S. Environmental Protection Agency, *Technical Support Document for Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units: State Plan Considerations*, p. 89.

27 For more information, see Center for Climate and Energy Solutions, "Energy Efficiency Standards and Targets," last accessed November 23, 2014, http://www.c2es.org/us-states-regions/policy-maps/energy-efficiency-standards

28 Carrie Jenks, Christopher E. Van Atten, and Tom Curry, *Multi-State Responses to GHG Regulation Under Section 111(d) of the Clean Air Act*, p. 10.

29 U.S. Environmental Protection Agency, *Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units*, p. 34830, 34874.

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