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Carbon Markets 101: "How-To" Considerations for Regulatory Practitioners

Authors
David Littell and David Farnsworth

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Acronyms

CFTC Commodity Futures Trading Commission
CO_2 Carbon dioxide
CPP Clean Power Plan
EDU Electric distribution utility
EPA Environmental Protection Agency
ERC Emissions rate credit
ESCO Energy service company
ETS Emissions Trading System (EU)
IRP Integrated resource planning
MWh Megawatt-hour
NO_X Nitrogen oxide
PUC Public utility commission
RGGI Regional Greenhouse Gas Initiative
SO_2 Sulfur dioxide

1. Introduction

In the fall of 2015, the US Environmental Protection Agency (EPA) finalized its Clean Power Plan (CPP) rules under Section 111(d) of the Clean Air Act to lower emissions from existing power plants.[1] Under the new rules, states were given a year to submit either a final plan or a request for a two-year extension. Despite ongoing legal challenges that will likely delay this timeline, many states will still plan for implementation, including making decisions on compliance approaches from a wide universe of compliance options[2]—including decisions on whether to make a market-based approach part of their plans.

Carbon market-based compliance options have been shown empirically to support and enable investment in the most cost-effective approaches. To produce the benefits states want, the details of carbon markets' design must be considered carefully.

Among the significant issues state officials will examine is whether to establish and participate in multi-state or regional markets that trade carbon allowances or emission rate credits (ERCs). The EPA says that compliance with the rules can produce significant long-term savings for ratepayers and consumers, but that is largely dependent on how states implement the rules. None of the compliance options is cost-free in the short run or distributionally neutral, nor are the various compliance options equally efficient and economically beneficial for energy consumers and state economies. But market-based compliance options have been shown empirically to support and enable investment in the most cost-effective approaches.[3] To produce the benefits states want, the details of carbon markets' design must be considered carefully.

To that end, this paper sets forth approaches and practices to establish well-designed carbon allowance and ERC markets, including:

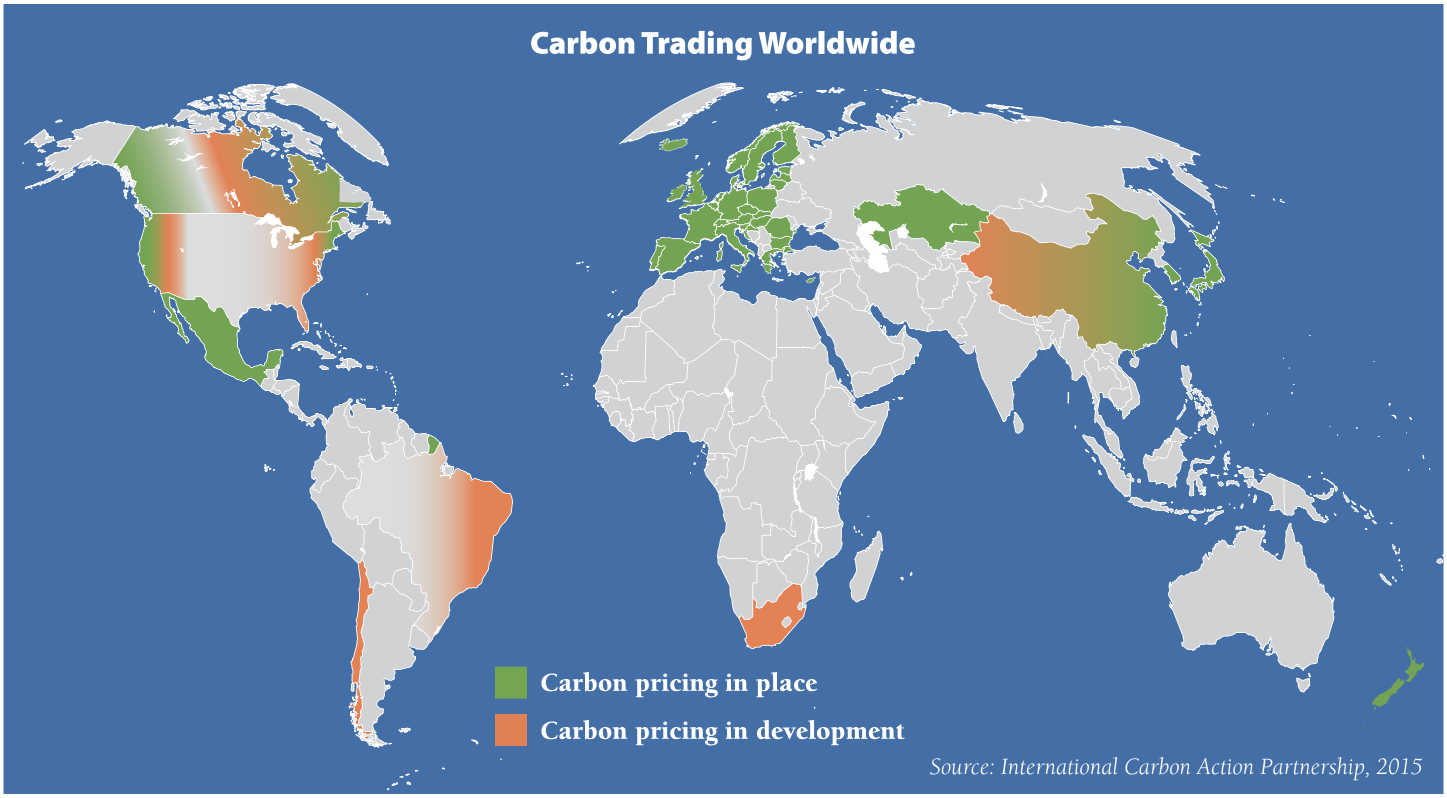
- The process the state undertakes;
- Whether to pursue a state or regional plan;
- Considerations regarding use of a mass-based or rate-based approach;
- Whether to limit ownership of allowances, and set rules for who can own, auction purchasing limits, and allowance holding limits; and
- Measures to minimize the potential for market fraud and manipulation.

1 The rules were published in the Federal Register on October 23, 2015. State submittals had been due by September 6, 2016. A recent stay by the US Supreme Court will affect the original date, pending the resolution of legal challenges to the program in court.

2 See, e.g., *Implementing EPA's Clean Power Plan: A Menu of Options.* Retrieved from http://www.4cleanair.org/NACAA_Menu_of_Options

3 See Organisation for Economic Co-operation and Development (OECD). (2013, November). *Effective Carbon Prices.* Paris: OECD Publishing; and OECD. (2013, October). *Climate and Carbon: Aligning Prices and Policies.* Paris: OECD Publishing, pp. 30-31. These sources draw research from 14 OECD member countries—the United Kingdom, Spain, South Africa, New Zealand, South Korea, Japan, Germany, France, Estonia, Denmark, Chile, Brazil, Australia, and the United States—and non-OECD member China. The OECD analysis concludes that carbon markets are significantly more efficient than other mechanisms, such as direct subsidies and feed-in tariffs. We should emphasize, however, that policies complementary to an electric sector cap-and-trade program are necessary, and that no single approach to carbon reduction presents a full solution. See Sections 4 and 6.2 of this paper for a discussion of achieving low-cost compliance with complementary policies. See also Hood, C. (2011, September). *Summing Up the Parts—Combining Policy Instruments for Least-Cost Climate Mitigation Strategies.* Paris: International Energy Agency. Retrieved from https://www.iea.org/publications/freepublications/publication/Summing_Up.pdf

Figure 1



The lessons drawn here are derived from operational energy markets and carbon markets across the world. More than 50 jurisdictions have set up emissions trading systems, which are operating today in 35 countries, 13 states and provinces, and seven cities around the world. These jurisdictions account for 40 percent of gross domestic product (GDP) in 2016.[4] Once the Chinese national system is put in place by 2017,[5] countries with more than 49 percent of global GDP will be covered by an emissions trading system for one or more sectors.[6] These operational markets illustrate important lessons in best management practices from those who have done this before.

4 International Carbon Action Partnership (ICAP). (2015). *Emissions Trading Worldwide: ICAP Status Report 2015.* Berlin: ICAP, p. 3; ICAP. *Emissions Trading Worldwide: ICAP Status Report 2016*, pp. 26-27.

5 Mehta, A. (2015, October 6). China Launches Nationwide Emissions Trading Scheme. *Chemistry World.* Retrieved from http://www.rsc.org/chemistryworld/2015/10/us-china-emission-trading-scheme-climate-change

6 ICAP (2016), pp. 26-27.

2. Basics of Market Design

As states review their options for allowance and ERC trading, they must keep in mind that good design is critical if market-based systems are to function well. Whether required under CPP implementation plans or independent state initiatives, proven best practices apply. Maintaining transparency and soliciting and making use of stakeholder input are critical at every step of market design and implementation. Stakeholders—including the regulated community—ultimately become participants, investors, commentators, and pillars of an efficient market.

Full understanding of and confidence in the market rules, as well as enforcement and oversight by state, regional, and national regulators, are also critical to providing the confidence necessary for development of stable market mechanisms. In turn, this confidence engenders energy sector investments that will support compliance and send accurate price signals to utilities, power plant owners and investors, and others who may generate allowances or ERCs.

Secondary markets for allowances and ERCs are a key element of market function, because they support liquidity and accurate price discovery following initial state distributions. That said, state air regulators do not directly regulate any secondary markets for emissions trading allowances or ERCs, nor should they. Recognizing this, states may want to consider how well the system they set up will support development of separate secondary markets.

Market design must also seek as much as possible to prevent fraud or manipulation. The design of tracking systems for allowances or ERCs and oversight mechanisms that provide a foundation for the development of a well-functioning market are important to ensure this. Governmental tracking requirements, oversight mechanisms, and regular market reports by oversight entities tend to facilitate open and transparent trading and create investor and public confidence in the market.

3. Ensuring Transparency in a State Market Design Process

A process of stakeholder engagement, which considers everything from initial conceptual discussions to recommendations on the system elements and then system design, is critical to informing regulators as to how best to design a carbon market. This process typically unfolds over multiple years, drawing lessons and best practices from the successful programs.

3.1 The First Step: An Open Dialogue With Stakeholders

An open and public process[7] is crucial for stakeholder and public acceptance and participation in a new market. Otherwise, market participants cannot know or understand what is being sold or held in the form of carbon allowances or ERCs, and consequently will not accurately value them.

Transparency of information during all phases ensures that the basis for investment decisions is clear to all market players. This gives investors confidence that there are no information disparities that would allow for unfair—or perhaps even illegal—access to critical market data. Designing a regulatory regime that distributes the same information to all market participants at the same time is critical to avoiding unfair access to important market data throughout implementation. Transparency is particularly important during program design and launch, as an open process helps regulated entities prepare, plan, and adjust to new programs' impact on their operations before the programs go into effect. Transparency enables a smoother transition.

Market development is more sound if the costs, benefits, and risks of different approaches—e.g., rate-based versus mass-based designs, or existing-source-only coverage versus new-and-existing-source coverage—are analyzed side-by-side with the same assumptions. It is also helpful if they are examined over similar time frames. As utilities and market participants look to operate with and invest in these markets, the initial discussion and understanding of market design decisions will inform their understanding and how they proceed.

3.2 Consensus-Driven Modeling of Costs, Benefits, and Risks

Stakeholder input informs not only basic compliance and market design, but also any modeling that is conducted. If modeling is used, it is important to ensure that its approaches and assumptions (e.g., generator mix, fuel prices, transmission line builds, and so on) are clear and easily understood. All assumptions should be transparent and, ideally, agreed upon (or at least commented upon) by stakeholders.

It is critical that officials require public vetting of modeling steps and assumptions so that market participants understand the basis for specific market design decisions. Modeling should also include a reasonable number of different scenarios and sensitivities to capture the range of plausible outcomes and illustrate how design choices can facilitate positive outcomes and mitigate negative ones.

Considering different model runs can illuminate the risks of different compliance approaches. For example, a series

7 The final 111(d) rule requires public process at the state level. For example, states requesting an extension of the September 2016 plan deadline must demonstrate opportunities for public comment on that request and on how the state intends to have meaningful stakeholder engagement in final plan development. A state requesting an extension must make a "demonstration or description of opportunity for public comment on the initial submittal and meaningful engagement with stakeholders, including vulnerable communities, during the time in preparation of the initial submittal and the plans for engagement during development of the final plan." §60.5765(a)(3). This emphasis on stakeholder participation in the final EPA rule provides the basic starting point for stakeholder input into state plans.

Figure 2

Creation of a Carbon Market

Design and Implementation Steps

1. Determine scope of the system
Power sector, transportation sector, industry, regional, other?

2. Choose type of system: (mass-based or rate based?) Establish an emissions budget or emissions rate

3. Allocation (auction or free?)
- Freely allocate (historically-based or output-based) or
- Sell at set price or through auction (allocate revenues, e.g., to energy efficiency, renewable energy, customer rebates, reduced program fees) or
- Hybrid approach

3.5 If a rate-based system, set rate credit mechanisms (scope of eligible activities and rate of credits)

4. Flexibility mechanisms and address volatility
Banking, borrowing, allowance price collar/cap; allowance reserve, offsets

5. Oversight and compliance assurance

6. Implement program
Clear start dates for market participants for market, oversight, and compliance (may be different dates)

7. Program review
Scheduled process for evaluation and improvement/corrections

Three important concepts are crucial to establishing an effective carbon market. They should be considered in many of the steps.

S – Share info
Public/stakeholder process/release of all information for feedback

M – Modeling
Select model type(s), input assumptions and sources for assumptions, scenarios and sensitivities, examination of range of results and benefits, costs, and risks

O – Oversight and compliance assurance
Identify market managers/monitors and compliance enforcer(s), select compliance mechanisms, conduct regular market oversight.

of model runs for projected low natural gas prices and a separate run for higher gas prices (and likewise for coal and other fuels) can illuminate variation in ultimate costs and pollution levels. Other model runs can assume the shutdown of various units that are at risk of retirement and incorporate new units, new transmission, or new demand-side and distributed resources as various solution sets. Varied levels of investment in energy efficiency, demand response, and renewable energy should also be examined. Further, the results of energy sector modeling[8] can be incorporated into economic models to show the relative net costs and benefits of different approaches to changes in the energy sector. In this manner, a variety of cost, benefit, and risk considerations can be examined publicly across multiple scenarios.

A word of warning from those who have done a great deal of energy sector modeling: Without transparency and clarity, modeling is easy to manipulate to produce pre-determined results. If the process fails to allow robust input from all stakeholders, the risk is high that, for example, a method selected may have high implementation costs, which would shift benefits to specific stakeholders and leave ratepayers with the costs. An open process will better enable states to fully consider different types of system designs, including different allowance allocations (or rate-based designs) and their resulting benefits and costs.

For example, allocating allowances to low-income rate relief could address any negative bill impacts for low-income consumers. Allocating allowances to energy efficiency and renewable projects under a mass-based system can reduce the overall costs of achieving reductions and stimulate states' economies. Free allocations to utilities or generators shift the benefits to the recipient utility or generator or to any other recipient. On the other hand, choosing a rate-based system would enable qualifying generators to create—and perhaps trade—ERCs, creating additional value for them. Thus, the value goes to the generators (or utilities owning generation) eligible to receive or "earn" the ERCs. Each compliance option shifts benefits in different directions and perhaps costs in another and has different economic impacts that state policymakers may want to weigh.

8 Energy sector modeling looks at costs of energy inputs such as fuel, capital costs, operations, and maintenance costs, taking the current power plant and transmission plants as given (and assessing new builds minus retirements) to assess future power plant and energy resources trends. With increased implementation of cost-effective energy efficiency and other demand-side load reductions, energy sector modeling now considers demand-side management and scenarios as well as examining grid needs. The Integrated Planning Model (IPM) is typically used by US EPA for energy sector modeling. EPA often uses Regional Economic Models, Inc. (REMI) for macroeconomic modeling.

4. Statewide or Regional Approach?

Generally, the broader a multi-state market, the more opportunities for savings would be expected because compliance costs would move toward the lowest-cost set of compliance approaches across the market area. Diversity between states (including diversity of generation and other electricity supply resources and diversity between opportunities for demand-side load reductions, including efficiency and demand response), as well as different state flexibilities to pursue complementary policies, suggest many supply and demand-side carbon abatement opportunities with different marginal abatement costs. A regulatory system that allows trading across these diverse jurisdictions will tend to achieve the least-cost carbon abatement outcomes if the market system is enabled to support movement from highest-cost compliance burden to least-cost compliance options from a variety of energy resources across jurisdictions.

Thus, classic economics would suggest that the lowest-priced carbon reduction measures in the electricity sector across multiple states can best be realized through multi-state and regional approaches. Although there is less experience with rate-based trading, in theory, the mechanics of a rate-based system can operate similarly to mass-based approaches that have a track record of success in multiple jurisdictions.

States that already are near their 2030 CPP targets or are projected to over-comply, such as Washington and California, may not need to use a multi-state approach. On the other hand, allowances or ERCs that such states could offer into the market would bring revenue into these selling states while simultaneously reducing the cost of compliance in the buyer states.

And it should be noted that multi-state systems need to be designed to be consistent with the commerce clause of the US Constitution, the Federal Power Act, and state public utility commission (PUC) and regional energy market rules.

5. Mass-Based or Rate-Based?

The 111(d) rule provides a half-dozen compliance choices, split into two basic approaches.[9] One is a "rate-based" approach, in which carbon emissions are regulated as a rate, i.e., expressed in tons of CO_2/MWh.[10] A rate-based credit as proposed by the EPA will be a tradeable instrument. The other is referred to as a "mass-based" approach, which counts total tons emitted per year under an emissions "cap." This approach relies on a system of tradable allowances, each worth one ton, that are tracked and can be traded. Because mass-based carbon markets have been more common, allow more design flexibility, and offer some unique market design features, we examine those features below, based on lessons learned in other jurisdictions.

5.1 Unique Features of a Mass-Based System

Mass-based systems have several unique compliance system design features.

- Mass-based options create the opportunity to readily trade allowances.
- Mass-based systems are familiar in carbon markets and to Eastern US states familiar with the Clean Air Act's Acid Rain Program. Mass-based systems operate similarly to the federal Acid Rain Program's approach for sulfur dioxide compliance.
- Mass-based systems create an opportunity to auction allowances, enabling auction revenues to be dedicated to public purposes.

Regarding this last point, market designers should be aware that allowances given away (to generators or utilities) provide a potential windfall benefit to the recipients.[11] Allowances have value, and giving those allowances to entities at no cost transfers that value for free. This is true of both utilities in restructured organized markets and vertically integrated markets.[12] Any CPP compliance costs would be paid by ratepayers.

By way of example, the European Union Emissions Trading System (ETS) illustrated this in its first compliance period when allowances were given for free to utilities, and utilities included their value in recoverable expenses nonetheless. This occurred in the United Kingdom and Germany. So European ratepayers paid for the value of allowances that were given to utilities even though the utilities received the allowances for free.[13] Learning from

9 The US EPA's 111(d) rule provides choices of compliance pathways, including at least three rate-based pathways. Most markets elsewhere are mass-based, with the large majority of carbon markets around the world adopting mass-based systems. See the International Carbon Action Partnership/ Cap Setting, which describes 17 programs with mass-based caps, retrieved from: https://icapcarbonaction.com/en/about-emissions-trading/cap-setting. See also Wing, I.S., Ellerman, A. D., & Song, J. (2009). Absolute vs. Intensity Limits for CO_2 Emission Control: Performance under Uncertainty. In: Tulkens, H., & Guesnerie, R. (eds.) *Design of Climate Policy.* Cambridge, MA: MIT Press. Authors explore differences between absolute and intensity-based emission limits.

10 The rate-based system adopted by the EPA is not strict end-of-stack rates but takes into account the ability to credit low-carbon and no-carbon energy into the overall state rates, so the rates are a "regulatory rate" construct.

11 For a more extensive treatment of carbon pricing effects in organized wholesale markets, see: Subcommittee on Energy and Environment, U.S. House Energy and Commerce Committee, (2009, March 12) (Testimony of Sonny Popowski, Consumer Advocate of Pennsylvania); see also: Cowart, R. (2008). Carbon Caps and Efficiency Resources, *Vermont Law Review,* (33), 201-223.

12 For an academic demonstration of windfall profits in a free allocation system, see Carmona, R., Fehr, M., Hinz, J., & Porchet, A. *Market Design for Emission Trading Schemes.*

13 With free allocations, "the market price will rise through the opportunity cost pass-through of the marginal supplier, even though the allowances do not represent out-of-pocket costs for generators. This rising market price offers the possibility of windfall profits for recipients of free allowances (higher price received without a corresponding increase in

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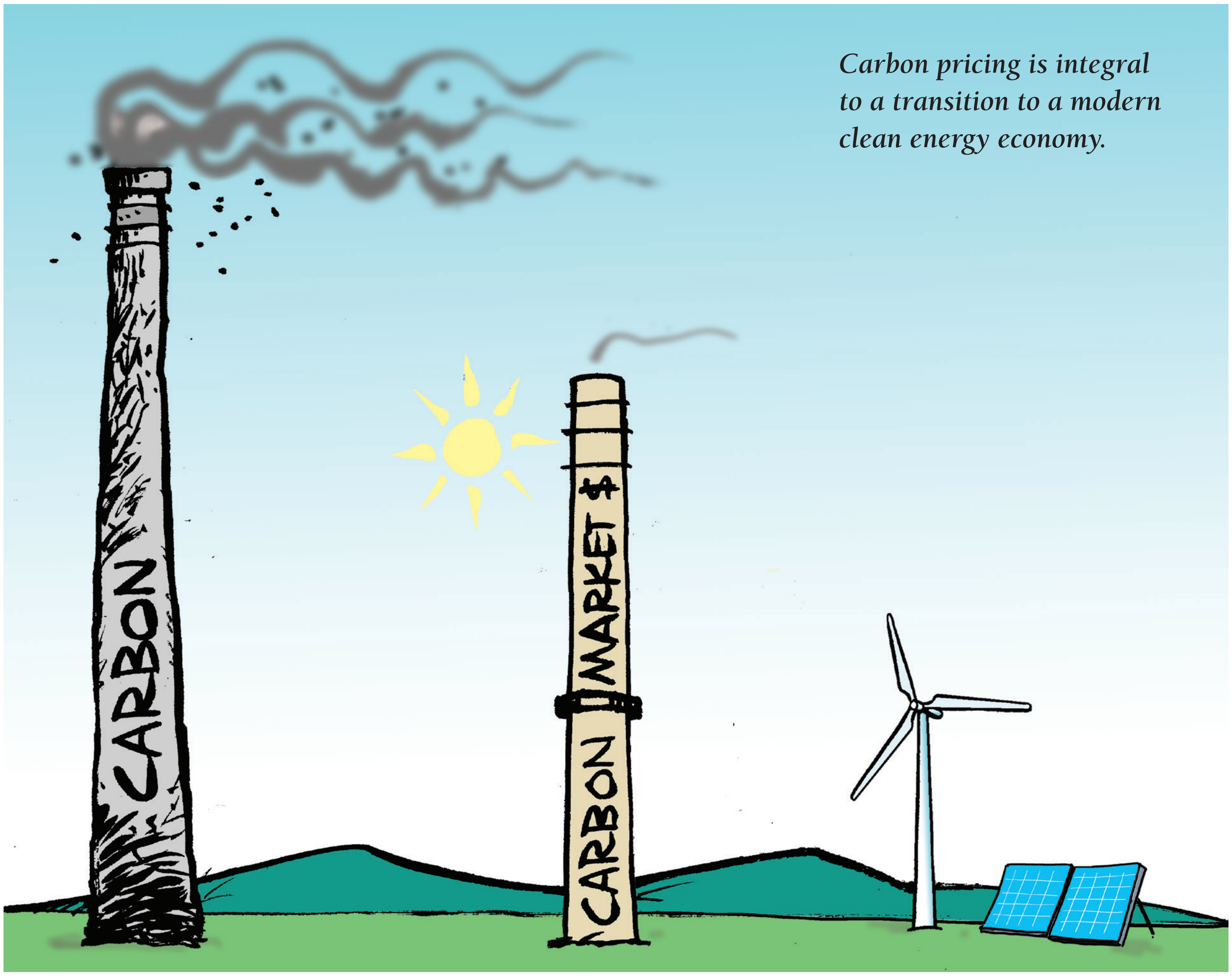


this experience, the states in the Regional Greenhouse Gas Initiative (RGGI) used an auction mechanism to distribute the vast majority of the RGGI allowances and explicitly dedicated the auction proceeds to consumer benefit purposes, such as funding energy efficiency and ratepayer rebates. Furthermore, while agreeing to allocate a minimum amount of allowance value for consumer benefit, the RGGI states currently allocate nearly 60 percent of allowance value for support of state efficiency programs.[14] Following the successful RGGI allowance auctions beginning in 2008 and 2009, the European Union and later California incorporated limited auction mechanisms into their allowance distribution systems.[15]

Auctions provide a clear and transparent market

input costs) as was found in the EU ETS before it auctioned allowances." Litz, F., & Murray, B. (2016, March). *Mass-Based Trading Under the Clean Power Plan: Options for Allowance Allocation.* Nicholas Institute and Great Plains Institute, Working Paper NI WP 16-04. For more on the European experience, see: German Federal Ministry for the Environment. (2014, October 15). *European Emissions Trading Scheme: The German Experience* [Presentation], slide 10. Retrieved from https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/3420149/0633975ADD717B9CE053C92FA8C06338.PDF; Baldwin, R., Cave, M., & Lodge, M. (2012). *Understanding Regulation: Theory, Strategy, and Practice.* Oxford, United Kingdom: Oxford University Press, p. 203; and Sijm, J., Neuhoff, K., & Chen, Y. (2006, May). *CO_2 Cost Pass Through and Windfall Profits in the Power Sector* [Working paper]. Cambridge, England: Electricity Policy Research Group. Retrieved from http://www.eprg.group.cam.ac.uk/wp-content/uploads/2008/11/eprg0617.pdf; FERN. *Case Study 3: Carbon trading in practice — the EU Emissions Trading Scheme.* Retrieved from http://www.fern.org/es/node/5201.

14 Hibbard, P., Okie, A., Tierney, S., & Darling, P. (2015, July 14). *The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic States: Review of RGGI's Second Three-Year Compliance Period (2012-2014),* Figure 2, p. 33. Boston, MA: Analysis Group. Retrieved from http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_july_2015.pdf

15 See Carmona, et al.

mechanism for price discovery. Even if a small percentage of allowances is auctioned, this can give the market important price information and improve market functioning. The EPA's Acid Rain Program withholds about three percent of allowances in order to sell some at a fixed price and to auction the remainder; this functions to provide the market with basic price information.[16]

Either by direct allocation, distribution, or use of auction proceeds, allowances can be used for public purposes. These purposes include consumer benefits, such as funding:

- Energy efficiency programs and projects;
- Low-income efficiency and weatherization;
- Development of distributed energy resources (such as solar panels or other local energy resources);
- Bill credits to all customers;
- Low-income bill assistance or bill credits; and
- Development of low-carbon technologies, market development for deployment of low-carbon technologies, or a combination thereof.

According to the EPA, mass-based compliance systems offer approximately 40 percent lower costs than rate-based options.[17]

In contrast, the beneficiaries in a rate-based system are those units that operate below the required emission rate and those units and resources that can generate ERCs, such as energy efficiency, renewables, and highly efficient gas plants. A rate-based system will be advantageous from a cost viewpoint if, for example, compliance with the rate-based requirement is already predicted by modeling under business-as-usual energy sector developments through 2030.

16 Peskoe, A. (2016, January 27). *Designing Emission Budget Trading Programs Under Existing State Law.* Harvard Law School, Harvard Environmental Policy Initiative, p. 5.

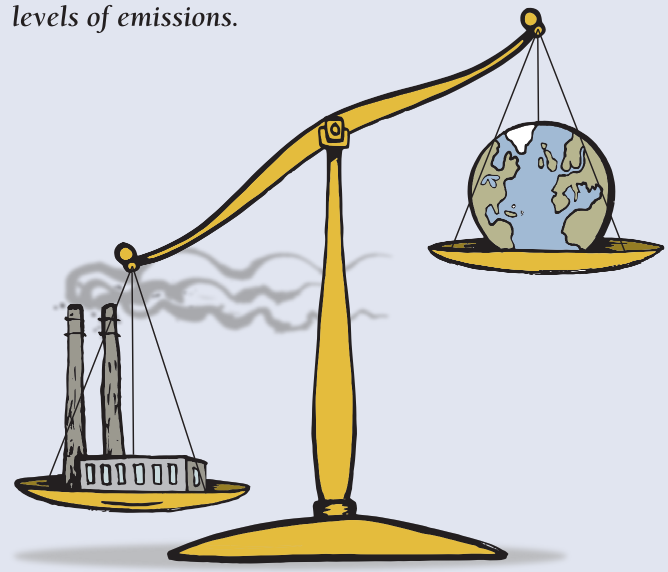
17 The EPA estimates the costs of mass-based plans at $5.1 billion in 2030, compared with $8.4 billion cost for rate-based plans in the same time frame, and estimated benefits of $34 billion to $54 billion per year in 2030. US EPA. (2014, June). Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Plants. EPA-452/R-14-002.

6. Initial Allocations and Secondary Market Development

If states implement their own programs, they have wide latitude in making decisions about how to allocate and distribute[18] allowances, including auction mechanisms to allow the market to determine prices. The states also have wide latitude to set ownership rules and tracking requirements. These requirements are vital for the development of secondary markets (i.e., markets where allowances and ERCs can be traded following their initial distribution). Secondary markets can operate on commodity exchanges such as the InterContinental Exchange or via direct company-to-company transactions called "over-the-counter" trades.

Why would a state want a secondary market to develop? One reason is so allowances or ERCs can be traded freely and be available for purchase and sale by sources when needed. This is what economists call *liquidity:* the goods in the market are available to those who need to buy or sell when the need arises. If a market is not liquid, entities holding the goods can exercise disproportionate market power to alter prices by withholding from the market (to push prices up) or dumping into the market (to push prices down). In the extreme example, without any secondary market, entities owning allowances or ERCs could arbitrarily assign value to them, whether high or low, without any independent market to validate that assigned value via price discovery. How much of that value should be incorporated into utility rates paid by ratepayers would then become a complicated, convoluted, and perhaps litigated matter of public utility accounting and regulation. Liquidity eliminates the need for utilities or generators to tie up capital purchasing allowances until needed for compliance, which provides compliance flexibility though a readily available market.

Polluting for free creates an economic externality that tilts markets to excessive (and inefficient) levels of emissions.



In a mass-based system, the allowance allocation and distribution mechanism will determine the initial set of market players. Notably, the ownership rules could facilitate or frustrate development of a secondary market. If ownership by non-compliance entities is allowed, for example, then a secondary market can—and likely will—develop.[19] The bigger the secondary market in terms of price and volume, the more likely it is to develop and the more likely commodity exchanges are to set up trading desks and standard trading contracts.

There are a variety of ways to allocate and distribute

18 Allocation is used in this paper to indicate the legal grant of allowance ownership rights under each jurisdiction's rules. Distribution is used to indicate the actual process of transferring ownership of the allowance or ERC.

19 In a rate-based system, the tracking of credit is slightly more difficult to conceptualize. There is a net transfer of ERC value from units with emissions rates higher than the adopted emissions rate standard to those entities that are allowed to generate ERCs. There is thus ERC value transferred to highly efficient existing natural gas combined cycle plants, to renewable and nuclear projects built in 2013 and later, and for energy efficiency projects for non-emitting megawatt-hours in years 2022 and after.

Rate-based emissions reduction credits and the Clean Energy Incentive Program provide direct credits for renewable energy.

allowances. Under the proposed federal plan, after set-asides,[20] the EPA proposed that allowances be distributed to existing power plants based on historic generation. Under the EPA's plan, initial holders of the allowances would be the utilities or owners of the power plants. There are also three optional set-asides proposed in the federal plan, for:

1. Clean Energy Incentive Program early action credits;
2. Gas plant emissions; and
3. Renewable energy allocations.

Additional set-asides, such as for energy efficiency, are not part of the proposed federal plan but could be incorporated into a state's planning if the state so chooses.

However allowances are distributed, a larger trading market generally reduces costs, increases liquidity, and reduces price volatility. A carbon market encompassing an entire electricity region (such as a balancing area) or area served by one or more discrete utilities would facilitate trading among the known market participants in that region. A market serving a larger set of entities is more likely to be liquid and enable price discovery if it covers multiple states, utilities, and regions. So everything else being equal, a multi-state or regional market is likely to provide greater liquidity and more opportunity to identify lowest-cost compliance options among the various electricity sector players than a single, small state market. A market encompassing a larger set of entities is also likely to reduce cost risk and price volatility as supply and demand options expand across a larger group of buyers, sellers, types of compliance entities, compliance options, and geographies.

6.1 Auctions Have Been Used Successfully in Other Greenhouse Gas Emission Reduction Systems

The RGGI states, European Union, and California all auction some or most of their allowances. Auction mechanisms allow for initial price discovery via the auction clearing price. These auctions are based on energy market designs in regions with competitive energy, capacity, and ancillary service markets. There is no reason, however, why

20 The EPA proposes a number of allowance set-asides to address leakage to new sources (not regulated under the CPP) to incentivize new renewable generation and redispatch to existing natural gas plants that are regulated under the CPP.

allowance auctions cannot also work in vertically integrated US states (where electric utilities are regulated by a commission). Vermont remains both a vertically integrated utility state and a RGGI state, and New Hampshire's largest utility still owns its generation through 2016. Both the Vermont and New Hampshire examples as RGGI states demonstrate that vertically integrated states and utilities can operate well as part of a multi-state carbon trading system.

Energy markets are often administered regionally under specific auction rules. The rules are not only known to auction participants well in advance of the auction, they are developed with stakeholder input. Carbon allowance auctions were designed with these successful energy market design elements in mind. For example, to ensure that only serious and qualified bidders participate, financial security is required in the form of cash or letters of credit for all bidders. Furthermore, a qualification process is required to ensure that only legitimate buyers participate in the auctions. These rules prevent bids from entities that have no intention of purchasing allowances and thereby reduce the likelihood of speculative bids. There are often both minimum block bid requirements and maximum purchases limits. And it should be noted that an auction need not include all allowances (or nearly all, like the RGGI auctions) in order to provide effective price discovery. As noted previously, the Acid Rain Program auctions less than three percent of allowances, but that is enough to provide effective price discovery.

Market-based auction systems also provide a mechanism in which states can direct the economic value of CO_2 emission allowances to legislatively or otherwise determined public purposes. For example, the RGGI States as a whole dedicate more than 90 percent of their allowance proceeds to public purposes including energy efficiency (62 percent), direct bill assistance (15 percent), greenhouse gas abatement (9 percent) and clean and renewable energy (8 percent), with the rest to administrative costs and other purposes. Although these figures are overall averages across nine states, states within RGGI vary in their allowance dedications, according to each state's policy priorities. Maryland, for example, dedicates a share of its allowance auction proceeds to direct low-income bill assistance.[21]

Carbon markets use classic economic pricing to tilt the markets away from excessive pollution and toward efficient solutions.

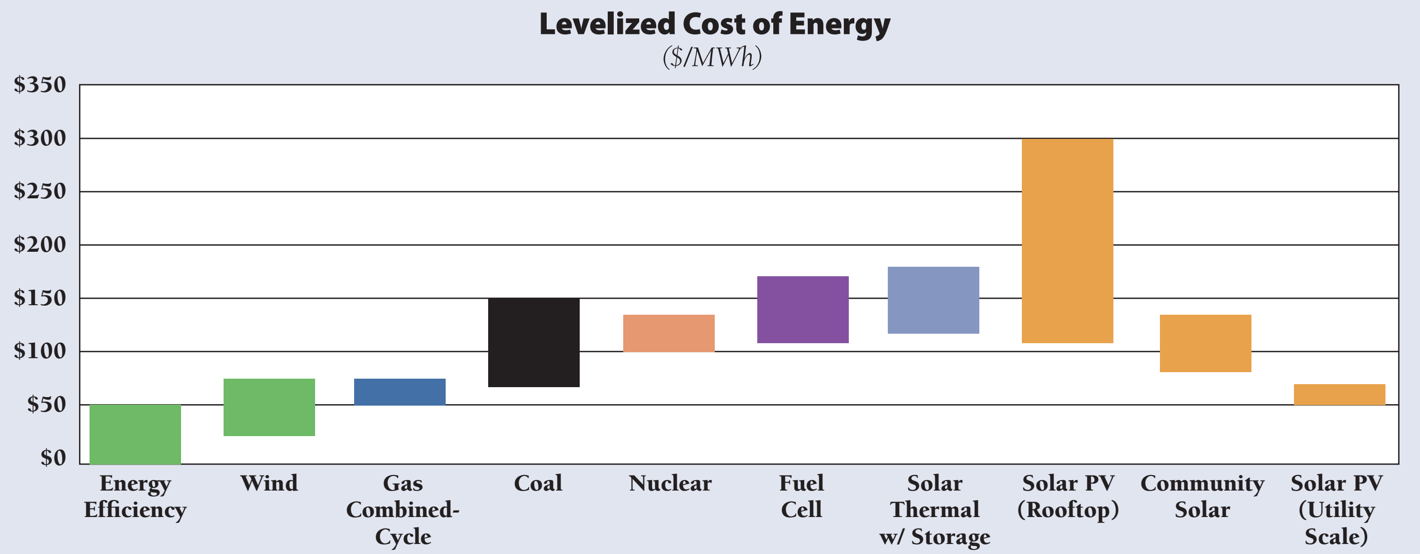
6.2 Achieving Low-Cost Compliance

Market-based allowance systems offer both the opportunity to minimize compliance costs and to direct benefits based on legislative or executive mandates. Pricing carbon can send efficient signals for allocation of resources by market players considering investment decisions that would direct capital at such choices as new power plants, energy efficiency, renewables, or any number of other electricity sector investments.[22] This can be accomplished through market-based systems, with or without auctions, or possibly through distribution and allocation to local

21 For detail on the RGGI states' use of allowance proceeds and benefits flowing from that use, see: Investment of RGGI Proceeds through 2013 Report. (2015, April). Retrieved from http://www.rggi.org/rggi_benefits

22 An econometric analysis of the RGGI states' CO_2 emission reductions of more than 40%, conducted by Brian Murray of the Nicholas Institute at Duke University and Peter Maniloff of the Colorado School of Mines, concluded that roughly half of these emissions reductions are due to RGGI itself, while reductions in the price of natural gas, the economic recession, and the renewable portfolio standards in these states had lesser but still significant explanatory power. See Murray, B., & Maniloff, P. (2015). Why Have Greenhouse Emissions in RGGI States Declined? An Econometric Attribution to Economic, Energy Market, and Policy Factors. *Energy Economics* 51, 581–589.

Figure 3



Costs vary regionally, but overall the lowest-cost resources are energy efficiency, wind, and large-scale solar PV (in that order). Source: Lazard, 2015.

electric distribution utilities (EDUs).

In states with traditional vertically organized utilities or in restructured states with organized wholesale markets, another method of distribution could be to allocate allowances to EDUs (also known as retail electricity companies or load-serving entities) and require those companies to sell the allowances to power generators, capturing the revenue for the benefit of ratepayers or consumers. EDUs can be ordered to do so by state PUCs under their existing authority in most jurisdictions. This method may not, however, result in arms-length sales if the EDUs also own power generation (or are commonly owned by an entity that also owns generation). To address this, an open auction, combined with broad rules on who can own and specific holding limits to facilitate a broader market, may be advisable.

States with vertically integrated utilities can use integrated resource planning (IRP) processes and similar mechanisms to identify least-cost compliance strategies. As explained further below, those strategies will only be low cost if they take an integrated view of all energy resources. This requires consideration of supply-side and demand-side resources and all relevant environmental compliance requirements (i.e., a multi-pollutant analysis)[23] to assess long-term costs and benefits over a range of reasonable scenarios, rather than focusing solely on CPP compliance.

In fact, states that are vertically integrated have something of an advantage in being able to look at all supply-side, demand-side, and other complementary renewable and efficiency programs in an integrated manner. States that have restructured and now have retail competition can also undertake statewide planning to design complementary policies to promote low- and no-carbon resources. But the scope of the statewide planning and the implementation of some complementary policies may be more complicated in a retail competition state.

6.2.1 Consider Integrated Energy, Air, and Environmental Costs and Benefits Planning

IRP should consider the broad spectrum of environmental planning issues that affect potential costs of energy resource acquisition. Traditional IRP looks at least-cost planning for energy resources procurement and operation over a period of years. Resources evaluated typically include generation and transmission resources, including renewables and energy efficiency. The most current long-term costs for varied energy resources are set forth in Figure 3.

Integrating an energy resource review based primarily on economic principles of utility regulation with an environmental review based on meeting environmental mandates makes a lot of sense. In the ideal situation, a PUC-run IRP process could be conducted in concert with state air, water, and solid waste regulators examining the multiple environmental and energy variables affecting the

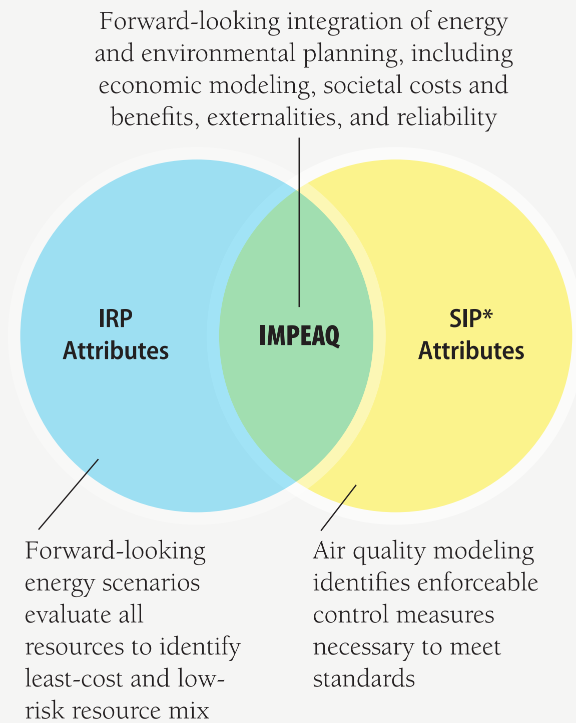
23 James, C., & Colburn, K. (2013). *Integrated, Multi-pollutant Planning for Energy and Air Quality (IMPEAQ)*. Montpelier, VT: Regulatory Assistance Project. Retrieved from https://www.raponline.org/document/download/id/6440

power sector between, say, 2016 and 2030. These variables include new and existing emission limits under the EPA's Cross-State Air Pollution Rule, Mercury and Air Toxics Standards, a new ozone standard, and fine particulate standards that can become more stringent over time, as well as regional haze, SO_2, and NO_X air standards. Other rules on the planning horizon that should be evaluated by states as part of their CPP analyses include new water intake and discharge rules for thermal effluent and toxic water pollution, as well as coal-ash impoundment and disposal requirements.[24] RAP's integrated, multi-pollutant planning for energy and air quality (IMPEAQ) concept proposes a method for identifying least-cost pathways to reduce emissions of multiple pollutants, while minimizing the impacts on electric reliability (Figure 4).[25]

The purpose of an inclusive and integrated review is to avoid decision-making in a vacuum. For example, a decision to upgrade a coal plant for compliance with the CPP may not account for the necessity to make upgrades for other air pollution controls or ash disposal requirements. Or a decision to replace a coal generator with gas unit may appear to be an effective CPP compliance approach, but may not take into consideration new ozone standards that would require the gas plant to secure different NO_X controls depending on the attainment status of the county where the plant is located. Likewise, a decision to model emissions without accounting for a strong state renewable portfolio standard (RPS) or efficiency program will not take into account emissions reductions from these other complementary state programs. Beyond new EPA regulations, the energy market itself is changing in ways that shift toward distributed energy resources and clean energy resources. And the risks of energy resources are not equal. Table 1 illustrates the relative risk of new generation resources. Taken together, it is possible for an upgrade or otherwise favorable compliance solution to become a more costly strategy for ratepayers—perhaps even a stranded cost—than alternative options once all long-term costs and risks are considered as a whole package.[26] When considered together, energy efficiency and renewable energy resources offer low-cost and low-risk solutions for many energy planning goals, including meeting new environmental regulations.[27]

Figure 4

Combining the Strengths of Traditional State Air Planning and State Energy Planning



** State Implementation Plan*

24 Farnsworth, D. (2014). *Further preparing for EPA regulations.* Montpelier, VT: Regulatory Assistance Project. Retrieved from https://www.raponline.org/document/download/id/6989

25 James & Colburn, 2013.

26 James & Colburn, 2013.

27 Binz, R., Sedano, R., Furey, D., & Mullen, D. (2012). *Practicing Risk-Aware Regulation: What Every State Regulator Needs to Know.* Boston, MA: CERES.

7. How Does Allowance/Credit Ownership Affect Market Development?

Utilities or generation owners may propose that ownership of carbon allowances or credits be limited to compliance entities (whether utilities or power plants) and no others. Under this approach, only compliance entities would be allowed to own or trade allowances (under mass-based systems) or ERCs (under rate-based systems). A small number of compliance entities have proposed this in existing carbon market regions.

Such a proposal, if adopted, would limit the potential market for allowance ownership and reduce market liquidity (i.e., the ability to buy and sell allowances). If limited ownership rules are considered, state officials should clearly identify the advantage(s) of limiting allowance ownership. Are there risks associated with a system that should limit trading to a very small market with few buyers and sellers? If a state is served by three utilities, are the three utilities able to trade among themselves? Would the resulting market be sufficiently transparent, liquid, and low-cost? Would the resulting market be more subject to manipulation by a small group of allowance owners? Are corporate affiliations disclosed so regulators can see if companies within the same corporate family are coordinating their market activities? Would the resulting market encourage providers of cost-effective compliance options such as energy service companies (ESCOs) to enter the market?

Markets function more efficiently when investors as well as compliance entities can buy and sell allowances. Markets with limited players are more susceptible to manipulation of supply and demand—and thus price. To minimize the risk of creating limited markets that would be subject to potential manipulation, the number of players should be weighed against the potential to exert supply-side and buyer market power. If there would be small numbers of either buyers, sellers, or both, or if players could potentially dominate supply or demand under limited ownership rules, the burden should be on the proponents of limited ownership to show how it will result in superior ratepayer, economic, and environmental outcomes. If modeling is cited to support limited ownership or closed ownership and trading, the modeling approach and assumptions (e.g., generator mix, fuel prices, transmission build from 2015 to 2030, etc.) should be clear, publicly transparent, and understandable as discussed above and below. Model outputs are no better than the model design, assumptions, and inputs that go into them, which is why those inputs should be discussed and vetted publicly.

Open Market Participation Is Important When You Know Who Your Participants Are

An important transparency measure is to be clear on who can open an account to own allowances and who can bid.

Measures to limit participation only to compliance entities can limit the ability of market players to protect themselves against price volatility and negatively impact market liquidity. This is so because the larger the number of market participants, the larger the chance a buyer or seller will be able to complete a transaction—increasing liquidity. Future and forward contracts can provide effective hedges against price volatility.

On the other hand, while a large number of market participants is generally beneficial, verifying the identity and previous records of market participants is an important requirement for opening an account with a tracking registry and preventing fraud and manipulation. Corporate affiliations need to be understood, and maximum purchase requirements can prevent a single buyer or coordinated affiliates from "cornering the market" in an auction. In practice, disclosure requirements, market monitoring, and liquid markets have prevented any hints of this type of market manipulation.

8. Energy Markets and Modeling the Future

8.1 Energy Markets

Air regulators would benefit from having a basic understanding of how energy markets operate in their state and region.[28] History has proven that geopolitical forces, weather, and economic events can have a dramatic and unpredicted impact on energy markets. Oil production levels in Saudi Arabia and wars in the Middle East directly influence the price of US crude and fuel at the pump, for example, and increased exports of US oil and natural gas can be expected to have a price impact in the future. Predicting energy futures is a precarious undertaking that even most expert firms can easily get wrong.

For air regulators, the best compliance options would incorporate regulatory flexibilities to allow the regulated community to adjust to changes in energy markets. Enabling compliance through a variety of mechanisms

Table 1

Relative Risk Exposure of New Generation Resources

Price and risk determine the relative cost and reliability exposure of future energy resource portfolios.

Resource	Initial Cost Risk	Fuel, O&M Cost Risk	New Regulation Risk	Carbon Price Risk	Water Constraint Risk
Biomass	Medium	Medium	Medium	Medium	High
Biomass Co-firing	Low	Low	Medium	Low	High
Coal IGCC	High	Medium	Medium	Medium	High
Coal IGCC-CCS	High	Medium	Medium	Low	High
Efficiency	Low	None	Low	None	None
Geothermal	Medium	None	Medium	None	High
Large Solar PV	Low	None	Low	None	None
Natural Gas CC	Medium	High	Medium	Medium	Medium
Natural Gas CC-CCS	High	Medium	Medium	Low	High
Nuclear	Very High	Medium	High	None	High
Onshore Wind	Low	None	Low	None	None
Pulverized Coal	Medium	Medium	High	Very High	High
Solar - Distributed	Low	None	Low	None	None
Solar Thermal	Medium	None	Low	None	High

Source: Ceres, 2014. CC = combined cycle; CCS = carbon capture and storage; IGCC = integrated gasification combined cycle; O&M = operations and maintenance; PV = photovoltaic

28 Electricity control regions are separated across the US, still allowing for transfers between most of these regions. In many portions of the country, Regional Transmission Operators or Independent System Operators (RTO/ISOs) maintain grid reliability, operate electricity markets for their respective regions, or both.

can help compliance entities adjust to shifting energy market realities, thereby reducing costs. A well-regulated carbon market is one that provides both a mechanism to ensure compliance, coupled with sufficient flexibility to allow compliance under a broad range of future market conditions.

"The RGGI program is built on stakeholder input, strong analytics, and expert advice."

8.2 Usefulness and Limits of Electricity Sector Modeling

Extensive market modeling is often done by PUCs, regional grid operators, and individual utilities. As noted previously, there are many ways to model the utility sector. Selection of the appropriate model and an understanding of the purpose in undertaking the modeling effort should be a transparent and deliberate process.

Because energy prices for natural gas, coal, and oil can be volatile, it is important to understand how these assumptions will fit into a model. Those unfamiliar with modeling should be aware that some models help inform decisions, but all models are just that: *models* used to characterize the future. Given all of the variables affecting the energy sector, it is very difficult to predict the future of such a complex system, and any modeled predictions are likely be off by some degree. Different futures scenarios can illustrate how the future may vary if key variables change and thus are used to illuminate risk. Modeling is more likely to be predictive on a shorter time horizon, given all of the variables in the system.

Just as air quality modeling incorporates well-informed judgment factors and improves over time based on experience, so does electricity sector modeling. But it is critical to remember that there is no predictive certainty to any energy system modeling, no matter how sophisticated it is. Risk, as well as least-cost planning, needs to be considered, and some energy resources exhibit more risks and different risks than others resources. The types of risk typically present for each energy resource category are identified in Table 1.

That said, the best modeling looks at a variety of future market scenarios, takes into account a range of uncertainties, identifies uncertainties and risk within reasonable bounds, and produces a set of likely (and less likely but perhaps higher-risk) outcomes for policymakers to consider. This is the strong analytic basis on which market design often proceeds.

Decision-makers can build a solid foundation for their market design by adopting modelling best practices, providing for transparency as described in Section 3, and incorporating the insights of market experts. One long-time RGGI staffer observes: "The RGGI program is built on stakeholder input, strong analytics, and expert advice."[29]

29 Interview with Lois New, Director, Office of Climate Change, New York Department of Environmental Conservation, Jan. 4, 2016.

9. Measures to Minimize the Risk of Market Manipulation

Market manipulation is not primarily a concern for air regulators. At the federal level, the Commodity Futures Trading Commission (CFTC) regulates future and forward contracts as well as commodity exchanges. Air regulators do not need to become experts in commodities regulation to set up an effective market. That said, there are some basics worth considering so the resulting market can function effectively and reduces the risk of fraud and manipulation. Some of these basics are:

9.1 Transparency

A clear, transparent market will limit the possibilities and opportunities for manipulation. The nature and importance of transparency are discussed in multiple parts of this paper.

9.2 Governmental Oversight

The extent to which state and federal regulators monitor the holding and trading of allowances or ERCs can discourage inappropriate activity. Market oversight provisions can have a significant influence on how efficient and liquid a market is, by establishing rules for who can participate, what exactly is traded, and how and where transactions take place. If these provisions are put in place, the market's vulnerability to manipulation and volatility will be minimized.[30]

9.3 Tracking System

Tracking of allowance or ERC ownership and trades will allow monitoring, examination, and investigation into holdings and trades that occur. In California and the RGGI states, allowance registration, monitoring, and tracking systems are already in place.[31] Other systems to track electricity transfers and renewable energy certificates (RECs) for compliance with electricity market or state regulatory requirements are also already in place across the United States.

9.4 Auction Participation Requirements

Energy market auctions in general—and carbon market auctions in particular—often require substantial financial security from participants, as well as a review of legal status and disclosure of corporate affiliate relationships. The financial security requirement ensures that only entities with the ability and intent to place real bids on allowances are permitted to participate in allowance auctions. If entities with no financial security were allowed to bid, the market might see more activity from entities unable or unwilling to close on their financial transactions.

In addition, a minimum and maximum purchase limit is often enforced. The maximum purchase limit ensures that no single entity can purchase a predominant number of allowances in any single auction. This limit is applied across all corporate affiliates, and because corporate affiliate disclosure is required, it cannot be subverted through affiliate purchases controlled by the same corporate family. Vendors that perform energy market auctions search corporate databases and other sources to ensure corporate affiliations are disclosed and reviewed. This has been done regularly for the US carbon trading systems currently operating, so again, air regulators do not need to become experts in corporate affiliates or even in how to run auctions. That expertise is readily available from experienced third-party companies.

30 Kachi, A., & Frerk, M. (2013). *Carbon Market Oversight Primer.* ICAP, p. 5.

31 See e.g, RGGI CO_2 Allowance Tracking System (COATS). Retrieved from https://www.rggi.org/market/tracking

9.5 Maximization of Allowances Offered for Purchase

The more allowances that are made available to the market, the less individual entities will be able to influence market outcomes. Likewise, the greater the number of purchasers, the more likely the market will function well. Whether an auction is administered directly by a state or by a third-party vendor, the greater the number of allowances offered for sale and the greater the number of authorized market participants, the more liquid the market will tend to be and the lower its risk of market manipulation.

Notably, in 31 allowance auctions over seven years as of April 2016, the RGGI market monitor has found no evidence of any manipulation or collusion in the RGGI auctions and markets.

9.6 Market Monitor

Electricity markets often employ market monitors to review the functioning of the market, the results of each auction, and secondary market trading trends. Market monitoring evaluates—through statistical and other techniques—whether there are any signs of manipulation, fraud, or collusion between market players. RGGI, for example, uses an independent market monitor to review the results of each auction, as well as the overall market on an annual basis, and the secondary markets on a quarterly basis. RGGI utilizes a well-known and well-regarded third-party energy market monitoring vendor, bringing the advantage of credibility to market participants and observers. Notably, in 31 allowance auctions over seven years, as of April 2016, the RGGI market monitor has found no evidence of any market manipulation or collusion in the RGGI auctions and markets.

9.7 Regular Reports and Accountability to the Market

As noted earlier, market monitoring reports can be made regularly available to market participants and the public. Reporting on activity in the tracking system (trades are usually considered confidential) can also be done on a periodic basis in lieu of or in combination with market monitoring reports. Regular reporting on monitoring and tracking provides confidence to market participants and the public that there is little probability of undetected market activity that could undermine the fundamental integrity of the market. Monitoring and reporting can also reflect on overall compliance status with market rules or regulatory requirements.

9.8 Information Exchange With Financial Regulators

In the US financial system, the authority of state regulators over commodity exchanges is limited. Federal regulation of future and forward contracts and commodity exchanges occurs through the CFTC. Nonetheless, state regulators and their tracking and auction administrators can share information on trades and activity with the CFTC and other federal entities. The awareness that this relationship is in place can help discourage inappropriate or illegal activities.

10. Transparency in Implementation and Regulation

Ensuring rules and practices that provide a level playing field for all participants is fundamental for a well-functioning market. The transparency needed to create the market is also needed to ensure that participants have equal access to information. This includes what is happening in the market, together with prices, volumes, and future regulatory changes. It is important to consider how information is gathered and published, who gathers and reports it and with what frequency, and how this information is made public.[32]

Once market rules, roles, and functions have been defined, administrative and oversight functions can be contracted or delegated to jointly established or regional entities familiar with energy market monitoring and functions. An example of this is when market monitoring is done under contract by an expert firm familiar with energy market auctions, secondary markets, and trading energy market obligations. A market monitor can assist with compliance and provide a transparency function through regular public reports. Transparent market operations ensure a level playing field and builds public confidence in the system. Some commentators have noted that, without appropriate transparency, effective oversight is difficult to impossible.[33]

One private utility representative noted the importance of private companies' understanding the functioning of the markets:

> *Industry wants well-functioning markets they know and can understand. From the early days of concern with how the [trading] market would develop, we are now at a point where some companies are saying "we want a strong carbon price." Coming up the learning curve has allowed companies in the region to become educated in how this market works and the benefits of a well-functioning market. A consistent price signal is a benefit of the review."*[34]

"The review" is a reference to the RGGI program review, which takes place every three years.[35] This review is undertaken via a public process and modeling similar to the process used to first set up RGGI, and it results in recommendations made on a periodic, predictable basis. All market participants know to expect the review, and it is undertaken with the same transparency as the initial market design and implementation.[36]

32 Kachi & Frerk, 2013.

33 Kachi, A. & Frerk, M. (2013). Citing Monest, J. (2010). *Climate Change and Financial Markets: Regulating the Trade Side of Cap and Trade.* Environmental Law Rep, 40, 1.

34 Interview with Brian Jones, Senior Vice President, M.J. Bradley, Feb. 8, 2016.

35 RGGI. (2012). Program Review. Retrieved from http://www.rggi.org/design/program-review

36 Littell, D., James, C., Farnsworth, D., & Speakes-Backman, K. (2016). *RGGI Program Review: A Model to Reduce Uncertainty in State Carbon Plans* [Forthcoming]. Montpelier, VT: Regulatory Assistance Project.

11. Conclusions

Carbon markets are functioning well in ten US states and many other national and sub-national jurisdictions. Through implementation across multiple jurisdictions, certain best management practices for regulators considering establishing such markets have emerged, which this paper details.

There are many advanced topics for regulators looking to refine carbon markets beyond the scope of this basic primer. But the information covered here is a useful overview to guide those considering market-based solutions for CPP compliance and beyond. The basic emphasis on transparent stakeholder engagement, establishment of open and well-monitored markets with reasonable oversight, and well understood rules will serve any regulator well.

Related Reading

RGGI Program Review: A Model to Reduce Uncertainty in State Carbon Plans

Forthcoming 2016

The experience to date of the Regional Greenhouse Gas Initiative (RGGI) has demonstrated the value of a robust program review mechanism, providing a possible model for international and other US states making plans to regulate carbon emissions. This paper reviews RGGI's foundations and details the history of how RGGI regulators and stakeholders designed program review practices. States can benefit from a mindset of continual improvement, as well as a thorough review process that goes beyond mere monitoring to reduce market uncertainty. The process also offers the opportunity to engage and work with parties affected by carbon regulations. While labor-intensive, the review process creates an open dialogue and clearly establishes the value of a transparent carbon management program.

Power Market Operations and System Reliability in the Transition to a Low-Carbon Power System

http://www.raponline.org/document/download/id/7600

As the power sector moves quickly toward decarbonization, authoritative research is demonstrating that a reliable transition that achieves economic, security, and climate goals is not only possible, but can be done at no more than – and possibly less than – the cost of "business as usual." To achieve this, however, the discussion about market design needs to shift from traditional notions to a focus on what kind of investment will most efficiently complement production from a growing share of variable resources. This paper, which follows from an earlier collaboration between RAP and Agora Energiewende for the European Pentalateral Energy Forum, is the latest in a series of RAP papers on how market design can efficiently facilitate the transition to a clean power sector. It points out that the debate over energy-only versus energy-plus-capacity markets, while important, misses the point to some extent. What is needed is a more comprehensive discourse about how to optimize the mix of market instruments, governance, and regulation to best capture the need for an increasingly flexible system – ensuring that low-carbon reliability solutions can be implemented at reasonable cost.

Complying With 111(d): Exploring the Cap-and-Invest Option

http://www.raponline.org/document/download/id/7007

With the US EPA's Clean Power Plan stayed, many states are exploring their next steps in search of a pathway enabling them to flexibly meet eventual carbon management compliance requirements in the least disruptive manner and at the lowest cost. The Regional Greenhouse Gas Initiative (RGGI), an electric sector CO_2 emissions reduction program for fossil generators established by Northeastern states, is the most prominent example of what has become known as a "cap-and-invest" program, and may be the model to emulate. While there is plenty of conventional wisdom about "cap-and-trade," there's far less understanding of cap-and-invest—states should not confuse the two. And as they decide their next steps, states might want to better position themselves by taking a page from the RGGI playbook, leveraging their own clean energy programs to address their electric sector CO_2 emissions, and ushering their economy into the 21st century.

Integrated, Multi-pollutant Planning for Energy and Air Quality (IMPEAQ)

http://www.raponline.org/document/download/id/6440

IMPEAQ is RAP's initial effort to develop a model process that states, local agencies, and EPA can apply to comprehensively and simultaneously reduce all air pollutants, including criteria, toxic, and greenhouse gases (GHGs). IMPEAQ seeks to identify least-cost pathways to reduce emissions of multiple pollutants by adhering to Integrated Resource Plan (IRP) principles. In doing so, IMPEAQ also seeks to minimize electric reliability impacts and other system impacts.

The Regulatory Assistance Project (RAP)® is a global, non-profit team of experts focused on the long-term economic and environmental sustainability of the power sector. We provide technical and policy assistance on regulatory and market policies that promote economic efficiency, environmental protection, system reliability, and the fair allocation of system benefits among consumers. We work extensively in the US, China, the European Union, and India. Visit our website at **www.raponline.org** to learn more about our work.

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50 State Street, Suite 3
Montpelier, Vermont 05602
802-223-8199
www.raponline.org