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Panel 1: Industry Experts

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1. What are indicators that wholesale energy and capacity markets are meeting a region's needs?

Centralized wholesale electricity markets are successfully meeting their original design objective, which is to supply electricity reliably and cost effectively. Operationally, the energy markets have delivered effective and efficient dispatch of resources on the system. Regarding generation investments and resource adequacy, the capacity markets have consistently met or exceeded target reserve margins at lower-than-expected cost. They have spurred innovation in demand-side resources, imports, uprates, and other unconventional resources that deferred the need for new generation by several years and provided capacity at a fraction of the cost of new generation. Recently, the markets have attracted merchant investment in new generation at prices well below the estimated net cost of new entry and some observed contract prices for new resources.

Relatedly, several prominent examples show how the centralized markets have worked in combination with other mechanisms to meet environmental regulations cost-effectively. SO_X and NO_X allowance trading has reduced harmful air emissions at compliance costs far below initial estimates; the allowance costs were seamlessly integrated into wholesale power markets, fostering competition to meet electricity needs and environmental needs at the lowest total cost. Similarly, the Regional Greenhouse Gas Initiative (RGGI) has been integrated into wholesale power markets. When the EPA's Mercury and Toxics Standards (MATS) forced coal generation owners to decide whether to retrofit or retire their facilities, capacity markets helped guide those decisions through competition with other resources in the low gas price environment. For example, in PJM, several thousand MW of coal plants were retrofitted, and over 18,000 MW retired and were replaced by other resources. These successes demonstrate the power of competition and the potential for centralized electricity markets to help achieve broader policy objectives.

The centralized wholesale markets do not, however, and should not be expected to meet goals they were not designed to meet. Many states now have far-reaching carbon and clean energy goals. Yet today's centralized

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[1] These comments and any errors are my own and do not represent the opinion of The Brattle Group or its clients. I wish to thank my colleagues Kathleen Spees, Johannes Pfeifenberger, Judy Chang, Dean Murphy, Metin Celebi, Marc Chupka, Jurgen Weiss, and Roger Lueken for their suggestions.

energy, ancillary services, and capacity markets are mostly not designed to differentiate generation resources based on their unpriced carbon emissions or other unpriced attributes.

2. Please explain whether wholesale energy and capacity markets can value or select additional operational attributes to respect state policies.

Some observers and market participants believe that state policy initiatives encouraging clean generation are at odds with wholesale power markets, or even that such state policies may undermine the viability of these markets. Of course, the policy initiatives are likely to induce a response that differs from what the markets would achieve in their absence. The question is, however, not whether these policy initiatives influence market outcomes—of course they do—but whether they do so in a way that impairs the market's ability to continue to support adequate investment to provide power reliably at reasonable cost. Another closely related question is whether it is possible to incorporate some state-level policy goals as enhancements to existing centralized markets. This might help avoid potential conflicts between policies and markets and also help achieve policy goals more efficiently and effectively.

The existing centralized wholesale markets can be enhanced to meet some types of state policy objectives. The main market design principles for doing so efficiently and effectively are to: (a) start with a clear, well-defined need, whether driven by reliability or public policies, that fits naturally with the existing product market (*i.e.*, MWh or MW, as discussed below); (b) develop a resource-neutral approach that enables all existing and new resource types to compete; and (c) remove barriers to entry for new entrants and innovative technologies.

3. Are there certain types of state policies that can be readily integrated into wholesale markets instead of pursuing state policies outside of the centralized energy and capacity markets? Are there certain types of state policies that can be readily integrated into centralized capacity markets, as opposed to centralized energy markets, and vice versa? Please explain.

Of all the state policy issues, decarbonization is emerging as the policy goal that is most readily integrated and that could most transform the generation fleet, costs, market fundamentals, and regulatory structures. Given the ambitious nature of some states' decarbonization goals over the next few decades (such as in New York, Massachusetts, Connecticut, and California), major investments will be needed in a variety of clean energy resources and end-use technologies. Harnessing competition will be critical for spurring innovation and guiding technology choices to help meet environmental and reliability objectives cost effectively. The centralized wholesale markets can best orchestrate this kind of competition if they are enhanced to incorporate the states' decarbonization objectives.

Whether energy or capacity markets are the most appropriate venues for integrating state goals depends on the nature of the goals and the attributes of the markets themselves. **Energy markets** are appropriate for addressing carbon emissions since CO_2 is a by-product of producing energy, and it is emitted in different amounts by different resources that compete in the energy markets.[2]

Capacity markets have been designed to efficiently meet resource adequacy standards. They are not well-suited for directly valuing goals that relate to energy production—such as clean energy goals that are about

2 In addition, energy and ancillary services markets are already evolving to create more incentives for flexible supply and demand that can help balance the variable output of renewable resources.

reducing the MWh of high-emitting generation. Capacity markets are similarly not designed to dictate requirements for fuel type, or baseload vs. peaking capacity, since the energy and ancillary service markets already recognize and distinguish the value of these attributes. Capacity markets can, however, help foster competition among all resource types, including those that earn more energy and ancillary services revenues and those that can monetize positive environmental attributes, so long as all resources' capacity ratings reflect their contributions to resource adequacy (which may be quite limited for variable energy resources, especially at high penetration levels).

Clean energy markets can implement clean energy goals through a market for zero-emission credits that can complement the wholesale energy and capacity markets. Advantages and disadvantages compared to other approaches are discussed below.

4. What are potential approaches to integrate state policies into wholesale energy and capacity markets, and what key tradeoffs should be considered when evaluating various potential approaches?

There is a spectrum of potential approaches to integrate state policies into wholesale markets. The more market-oriented approaches embrace competition and continue to place investment risks primarily on investors rather than customers. Such competitive market-oriented approaches are consistent with the restructured industry framework currently in place in most of the Mid-Atlantic and Northeast states. On the other end of the spectrum, less market-oriented approaches tend to give regulators more control over meeting requirements using targeted procurements or financial support.[3] The following discussion compares a range of approaches to meet state decarbonization objectives.

The most market-oriented approach to implementing a decarbonization policy is to price carbon emissions. Carbon emissions can be priced and internalized into energy markets through several possible mechanisms. Cap-and-trade is the method used in RGGI, although RGGI's current caps on carbon emissions remain far above some states' long-term goals, and the resulting allowance prices have been very low.[4] Taxation is an alternative approach that sets a specific price which markets can then incorporate. A third, closely-related approach is for the system operator to implement a carbon charge in its dispatch and settlement of the energy market; generation and imports are charged based on their emissions rates, and the collected revenues can be returned to customers to mitigate customer cost impacts.[5]

Any of these forms of carbon pricing will stimulate competition for reducing carbon emissions. Resources that emit less carbon than the price-setting marginal resource will be rewarded by an energy price that increases more than their own emissions costs; and the low-emitting resources that generate in times and places with the highest marginal emissions rates will be rewarded the most. Thus, when integrated with well-designed wholesale markets, carbon pricing can help simultaneously meet environmental, economic

3 Some also have considered, in the more extreme cases, a return to resource planning by utilities under cost of service regulation with centralized markets providing only dispatch signals. That looms as a possible end-state if markets and states cannot work together to meet both policy and reliability objectives.

4 The latest RGGI auction price was $3/short ton CO_2. California has an economy-wide cap-and-trade, with recent prices of $13.6/metric ton CO_2.

5 See Judy Chang, Jurgen Weiss, and Yingxia Yang. *A Market-Based Regional Approach to Valuing and Reducing GHG Emissions from Power Sector*. Prepared for Great River Energy. April 2014. Posted at http://www.brattle.com/system/news/pdfs/000/000/616/original/A_Market-based_Regional_Approach_to_Valuing_and_Reducing_GHG_Emissions_from_Power_Sector.pdf?1397501081.

dispatch, and resource adequacy objectives with the most cost-effective mix of resources. In regions with significant coal generation, carbon pricing would lead to cost-effective carbon abatement through re-dispatch to lower-emitting resources. In regions without material coal generation, re-dispatch alone would not substantially reduce emissions. Carbon pricing would lead to lower emissions primarily by retaining existing clean energy resources and incentivizing new investment and innovations that reduce carbon emissions. The market would select the combination of natural gas, wind, solar, storage, demand side, and existing clean resources that achieves the most carbon reductions at the lowest system-wide cost.

The political acceptability of introducing high enough carbon prices to support investment in new clean resources may depend largely on customer cost impacts. Customer costs may increase or decrease compared to other methods of achieving environmental goals, depending on market conditions and how carbon pricing is implemented. Returning revenues from carbon-related charges to customers would help minimize customer cost impacts. Another mitigating factor is that the price of Renewable Energy Certificates (RECs) or other clean energy products would be lower in the presence of a carbon price.

Investors may perceive substantial regulatory risk associated with carbon prices if a state's commitment to carbon pricing is not considered sufficiently durable. The investment risk is especially pronounced for clean resources, which are relatively capital intensive and rely on capturing the future value of their environmental attributes. However, this is not a reason to reject carbon pricing. Rather, it is a call to consider market designs that provide better investment signals, such as through multi-year carbon-pricing or clean-energy products.

Carbon pricing also faces some implementation challenges if states within a regional market have different carbon objectives, but these challenges should be manageable. One of the implementation challenges is the "seams" issue. For example, states with less stringent objectives would want to limit their exposure to the more stringent objectives of other states. This requires conducting dispatch and settlement in a way that imposes a carbon price only on the stringent states while avoiding "leakage" of emissions. Doing so is relatively straightforward in a single-state RTO such as NYISO, which could impose charges at the border. Within a multi-state RTO, efficiently preventing leakage is more complicated. The approach used for the Energy Imbalance Market that covers both California and other western states with very different carbon policies may serve as a starting point, but that approach is still being refined, and the idea needs to be developed further for multi-state RTO markets such as PJM or ISO-NE.

The second most market-oriented approach is deploying competitive clean energy markets. Ideally, such clean energy markets would maximize competition and innovation by admitting new and existing resources of all clean technologies (although they still would not provide as broad a price signal as carbon prices). Most existing state renewable procurement policies do not include all zero-emitting resources, such as existing nuclear or hydro generation, and therefore may not meet clean energy goals as cost-effectively as broader clean energy markets would.

Some states find clean energy markets a politically appealing way to implement their policies. For instance, when different states demand different quantities and/or types of clean energy resources, the various needs can be expressed through the product definitions in a regional clean energy market. When multiple states have similar demands, they can pool their requirements together and conduct more competitive auctions. Another politically attractive feature of clean energy markets is that states that do not value clean energy do not have to participate (although they may be affected positively or negatively by the clean energy market's interactions with energy, capacity, and ancillary services markets).

Traditional renewable energy products, or RECs, may require new product definitions if states expand their policy goals to include either emission reduction targets and/or clean energy requirements. New product definitions could: (1) expand eligibility to all clean resources and possibly even to storage and other technologies if they can reduce emissions; (2) incentivize development of clean-energy resources that will produce energy at the times and in the locations that avoid the most carbon emissions; and (3) allocate to suppliers most of the market risks associated with fuel prices, energy prices, load growth, and choice of technology but allocate to customers the regulatory risk that the clean energy policies may not be sufficiently durable. New clean energy markets can also be combined with carbon pricing to capture dispatch efficiencies and to sharpen locational price signals to guide more cost-effective investments.

Targeted procurements and direct financial support are less market-oriented. Some states may want to pursue specific opportunities or address immediate problems, such as the retirement of a nuclear plant that could significantly increase the challenge of meeting future decarbonization goals.[6] However, it may sometimes be difficult to determine whether targeted actions can reduce emissions at lower long-term cost than alternatives.[7]

When implemented on a limited scale, the impact of targeted measures on centralized wholesale markets may be modest and can be compatible with efficient markets. That is, some targeted support payments can result in an outcome that is consistent with that of carbon pricing. For example, a particular nuclear plant may have an implied carbon abatement cost below that of new clean energy resources and below the value a state ascribes to carbon emissions; such a plant would be in-the-money if there were an appropriate carbon price. If so, supporting such a plant should not be viewed as distorting the market but rather helping to internalize the environmental benefit of the non-emitting resource.

In contrast, targeted procurements and financial supports that are not consistent with coherent policy objectives may not be compatible with markets, particularly if implemented on a large scale. Such a departure from markets could lead to costly reliance on an ever-increasing amount of out-of-market payments that substantially reduce the size of the competitive market and erode investor confidence in the merchant generation model. To avoid such an outcome, states should aim to transition to more market-based approaches in the long-term.

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State clean energy policies can be integrated into wholesale market designs to yield efficient competitive outcomes and remain consistent with a vibrant merchant generation model. This should work even in a future where large amounts of clean energy resources benefit from additional clean energy revenue streams that reflect the additional value they provide. The prospects for a sustainable and efficient outcome are most promising if states are willing to rely on market-oriented approaches, such as carbon pricing or redesigned competitive markets for clean energy.

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6 See Metin Celebi, Marc Chupka, Frank C. Graves, Dean M. Murphy, and Ioanna Karkatsouli. *Nuclear Retirement Effects on CO_2 Emissions: Preserving a Critical Clean Resource*. December 2016. Posted at http://www.brattle.com/system/publications/pdfs/000/005/385/original/Brattle_Nuclear-Carbon_Whitepaper_-_Dec2016.pdf?1482159096.

7 For example, targeted support for early-stage technology may or may not produce net long-term benefits. See Jurgen Weiss, Mark Sarro, and Mark Berkman. *A Learning Investment-Based Analysis of the Economic Potential for Offshore Wind: The Case of the United States*. February 28, 2013.

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