BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF COLORADO

Proceeding No. 19M-0495E

IN THE MATTER OF THE COMMISSION'S IMPLEMENTATION OF §§ 40-2.3-101 AND 102, C.R.S., THE COLORADO TRANSMISSION COORDINATION ACT

COMMENTS OF THE INSTITUTE FOR POLICY INTEGRITY

The Institute for Policy Integrity at New York University School of Law ("Policy Integrity")[1] is pleased to submit these initial comments in the Public Utilities Commission of the State of Colorado ("Commission") proceeding to evaluate different options for electric utility participation in centralized electricity markets[2]—pursuant to the Colorado Transmission Coordination Act ("CTCA").[3]

Policy Integrity is a nonpartisan think tank dedicated to improving the quality of government decisionmaking through advocacy and scholarship in the fields of administrative law, economics, and environmental policy. Policy Integrity regularly engages with state utility commissions and the Federal Energy Regulatory Commission ("FERC") on the design of efficient electricity markets and regulations. Policy Integrity has been actively engaged in proceedings before the Commission, including submission of comments and testimony on the use of the Social Cost of Greenhouse Gases in Colorado's electric resource planning process and

[1] No part of these comments purports to present the views, if any, of New York University. Policy Integrity submitted a timely notice of participation in this proceeding on October 22, 2019. Jason Schwartz, Policy Integrity's legal director, lives and works in Denver, Colorado.
[2] For simplicity, we use the terms "centralized electricity markets" and "centralized markets" to refer to the range of electric market options outlined in the Colorado Transmission Coordination Act—energy imbalance markets ("EIM"), regional transmission organizations ("RTO"), and power pools.
[3] Colo. Rev. Stat. §§ 40-2.3-101 and 102.

other electricity policy decisions.[4] Consistent with the Commission's request for comments in Commission Decision No. C19-0756,[5] Policy Integrity now seeks to apply its economic, legal, and policy expertise to help inform the Commission on the costs and benefits of centralized electricity markets and on specific design choices for markets.

Policy Integrity makes the following points in these initial comments:

- Centralized markets improve efficiency of electricity dispatch; moving Colorado to a centralized market—whether by forming or joining a Regional Transmission Organization ("RTO"), participating in an Energy Imbalance Market ("EIM"), or expanding existing power pooling—would benefit generators, utilities, and customers.
- Centralized markets can be used to accomplish, and are compatible with, state energy goals.
- The Commission should consider environmental externality costs and benefits when evaluating centralized market constructs.

[4] *See* Comments of the Institute for Policy Integrity at New York University School of Law: Proposed Changes to ERP Rules 3604 & 3611, Proceeding No. 17M-0694E (Jan. 31, 2018), *available at* https://policyintegrity.org/documents/Policy_Integrity_Initial_Comments_on_SCC_to_Colo_PUC_013118.pdf; Comments of the Institute for Policy Integrity on the Social Cost of Greenhouse gases, Proceeding No. 19R-009E (March 29, 2019), available at https://policyintegrity.org/documents/Electric_Rule_NOPR_Initial_Comments_on_SCC_2019.3.29.pdf.

[5] Commission Decision Opening a Proceeding, Designating Commission Koncilja as Hearing Commission, and Soliciting Input from Interested Parties. Decision No. C19-0756 (Sept. 11, 2019) [hereafter "CTCA Order"].

I. Centralized Electricity Markets Have Demonstrated Benefits

The most basic result of economic theory is that "*perfectly competitive*" markets are economically efficient because they maximize the total net benefit of market participants.[6] In those markets, prices reflect the marginal costs of production and, therefore, serve as a signal for coordinating producers and consumers towards an efficient allocation of society's resources at the lowest possible cost.[7] Consequently, so long as a market satisfies the conditions of perfectly competitive markets, such as the absence of market power and free entry and exit, the outcome produced by the market is the best possible outcome from society's perspective.

The electric power sector in much of the United States, including in most of Colorado, is not currently structured as a competitive market. Instead, there is a single firm, a monopolist utility, which is responsible for serving electricity to a given territory. Because there is no competition that could drive down prices, these firms are usually regulated through rate-of-return regulation, allowing them to recover their cost-of-service as well as a reasonable rate of return on investments approved by regulators. If a utility wishes to buy or sell electricity from another utility, it must do so through a bilateral contract. In such a setting, the operation, investment, and consumption decisions of utilities are likely to be more costly than necessary.[8] Relative to this

[6] *See* PAUL KRUGMAN & ROBIN WELLS, MICROECONOMICS 106-09 (2d ed. 2009).
[7] *Id.* at 111.
[8] *See* Harvey Averch & Leland L. Johnson, *Behavior of the Firm Under Regulatory Constraint,* 52 AM. ECON. REV. 1052-69 (1962); Meredith Fowlie, *Emissions Trading, Electricity Restructuring, and Investment in Pollution Abatement,* 100 AM. ECON. REV. 837 (2010) (Showing and quantifying how rate-of-return regulation leads to an over-investment in capital intensive technologies.). *See also* Steve Cicala, *When Does Regulation Distort Costs?*

traditional arrangement, centralized markets for electricity provide benefits through enhanced coordination and price disciple. This basic fact has been known for almost forty years.[9]

Since the 1990s multiple states have recognized the potential for centralized electricity markets to increase social welfare and, as a result, have encouraged their adoption. This "grand experiment"[10] with centralized markets has provided academic researchers with the outcomes necessary to empirically evaluate if markets truly do improve efficiency in the electric power sector, and by how much. The resulting studies have used well-established econometric research techniques to evaluate the causal effect of centralized markets on trade flows and operation costs. Such academic research complements the efforts by market actors and other stakeholders to compute the delivered benefits of centralized markets.[11] The consensus is clear: centralized markets for electricity have demonstrated benefits in the electric power sector.[12]

Centralized markets produce benefits primarily by improving two types of efficiencies: (1) *system efficiencies*, enhancing "the coordination and use of multiple plants,"[13] and (2) *plant-*

Lessons from Fuel Procurement in US Electricity Generation, 105 AM. ECON. REV. 411 (2015); Kira R. Fabrizio et al., *Do Markets Reduce Costs? Assessing the Impact of Regulatory Restructuring on US Electric Generation Efficiency,* 97 AM. ECON. REV.1250 (2007) (Showing and quantifying how cost recovery leads to above-average fuel and labor costs.). *See also* Erin T. Mansur & Matthew White, *Market Organization and Efficiency in Electricity Markets*, YALE SCHOOL OF MGMT. WORKING PAPER (2009); Steve Cicala, *Imperfect Markets Versus Imperfect Regulation in US Electricity Generation,* UNIVERSITY OF CHICAGO WORKING PAPER (2019) (showing market-based dispatch reduces cost and increases trade relative to bilateral contracts.).

[9] *See* PAUL L JOSKOW & RICHARD SCHMALENSEE, MARKETS FOR POWER: AN ANALYSIS OF ELECTRICAL UTILITY DEREGULATION (1983).

[10] *See* James Bushnell & Severin Borenstein, *The US Electricity Industry After 20 Years of Restructuring*, 7 ANN. REV. ECON. 437 (2015)

[11] *See* e.g. CAL. ISO, WESTERN EIM BENEFITS REPORT, FIRST QUARTER 2019 (2019). https://www.westerneim.com/Documents/ISO-EIMBenefitsReportQ1-2019.pdf

[12] Bushnell & Borenstein*, supra* note 10, at 445 ("The creation and expansion of the RTO/ISO model may be the single most unambiguous success of the restructuring era in the United States . . . Although the early momentum for aggregating utility control areas into more regionally managed RTOs was provided by the belief that it was a necessary step toward the ultimate goal of deregulating generation and retail, the expansion of the RTO structure has come to be viewed as a valuable legacy of this period, even for states that never showed serious interest in these other aspects of restructuring.").

[13] *See* JAMES BUSHNELL, ERIN T. MANSUR & KEVIN NOVAN, REVIEW OF THE ECONOMICS LITERATURE ON US ELECTRICITY RESTRUCTURING 24 (2017), https://arefiles.ucdavis.edu/uploads/filer_public/e0/ee/e0eefda6-9fe2-4f88-8ca6-a00f25379754/restructuring_review.pdf.

level efficiencies, leading to "lower cost or higher availability at a particular plant."[14] Although both are relevant for evaluating whether Colorado should join a centralized market, the specific constructs the Commission is evaluating in this proceeding—RTOs, EIMs, and power pools—have the greatest potential to improve *system efficiencies*.[15] As a result, the following sections focus on the mechanisms by which centralized markets can increase system efficiencies.

A. Centralized Electricity Markets Reduce Generation Costs and Increase Trade

Two features of electricity make it different from other economic products and markets. First, in order to avoid reliability problems, at all times there must be a near-perfect balance between the quantity of electricity produced and the quantity demanded. Second, the constrained capacity of transmission and distribution network infrastructure creates physical limits on how much electricity can be delivered at a given location at a given time. These two features make coordination of electricity generators essential, as the following paragraphs detail.

The need for balancing supply and demand in real time requires coordination in order to prevent waste. Without coordination, different electricity generators could simultaneously generate electricity to supply the same increment of electricity demanded. At the same time, there should be enough generation capacity available to meet any sudden changes in electricity demand. If not, there is the risk of costly blackouts or that electricity generators will be physically damaged.

Coordination is also essential to ensuring that transmission and distribution network constraints do not preclude otherwise-economic transactions from occurring. For example, even

[14] *Id*.

[15] *Plant efficiencies* would be more prominent in a proceeding evaluating the benefits of deregulating vertical-integrated utilities. Because such deregulation does not appear to be a component of the CTCA, these comments do not focus on the potential to improve plant efficiencies. However, if the Commission is interested in information on the benefits of deregulation, we would be pleased to add material to the record that outlines such benefits and explains the opportunities for centralized markets and utility deregulation to work together to improve efficiency.

if two utilities are willing to trade electricity at a mutually agreed upon rate, transmission congestion constraints from a third party could render that transaction impossible. As a result, that transaction that would have benefited both parties cannot take place, resulting in a lost economic opportunity. These "congestion externalities" are difficult for utilities to resolve in a decentralized fashion, because utilities lack sufficient information on the use of the transmission infrastructure.[16]

In many jurisdictions, the coordination of electricity generators is left to each individual electric utility, which serves as its own "balancing authority."[17] Each utility takes a command-and-control approach to ensuring the balance of supply and demand within its footprint. These utilities are compensated through cost-of-service regulation, for all operation costs, and so do not necessarily have an economic incentive to dispatch the generators in a way that will minimize costs. And, if utilities want or need to exchange energy with other utilities, they currently have to rely on bilateral contracts.

In contrast, centralized electricity markets (such as RTOs, EIMs, and Power Pools) are based on the idea of economic dispatch. Here, an independent market operator aggregates information on transmission congestion constraints and dispatches units based on their submitted bids. The market operator then coordinates a large pool of electricity generators to meet supply at the lowest possible cost based on these bids, given the potential transmission network constraints. This coordination of electricity generators decreases total operation costs and allows electricity to be traded across transmission lines with less network congestion. Furthermore, because this operation of wholesale markets incentivizes generators to bid their marginal costs to

[16] Mansur & White, *supra* note 8, at 1.
[17] Cicala (2019), *supra* note 8, at 3. A balancing authority is "[t]he entity that has historically determined which power plants operate to meet demand." In Colorado this would be an investor-owned utility, a municipal utility, or a co-operative utility.

not miss out on any trading opportunities, the market outcomes and prices would be similar to the outcomes of perfectly competitive markets.

Two key studies in the economic literature have empirically validated the economic theory that centralized markets improve system efficiency and so, on the whole, benefit electricity producers and consumers. These studies are able to calculate the benefits by documenting the change in trade flows[18] and generation costs after the expansion or creation of a centralized energy market in the United States.[19] The increase in trade flows is an efficiency improvement so long as the traded electricity costs less to generate then the electricity it is displacing. The utility purchasing electricity is able to provide the same service to customers at a lower cost, and the utility selling electricity has additional profits from selling more electricity. Beyond improved trade, centralized markets improve system efficiency by incentivizing and prioritizing lower-cost electricity generation through price signals.

The first study analyzes an expansion of PJM Interconnection ("PJM") in October 2004 to incorporate nineteen additional electricity generating firms that had previously traded exclusively through bilateral contracts.[20] The figure below shows that after joining PJM, the volume of electricity these firms traded with PJM entities more than doubled. The increase in trade occurred because centralized operation allowed the lower-cost electricity generating units from the nineteen electricity generating firms to displace higher-cost electricity generating units in PJM, resulting in an overall cost saving (or "gains from trade") that exceeded $150 million per year.[21] The authors of this study attribute the efficiency gains to the centralized market's

[18] Trade-flows are the quantified import and export of electricity between balancing authorities.
[19] BUSHNELL, MANSUR & NOVAN, *supra* note 13, at 25; Cicala (2019), *supra* note 8, at 6.
[20] Mansur & White, *supra* note 8, at 15.
[21] *Id.* at 53.

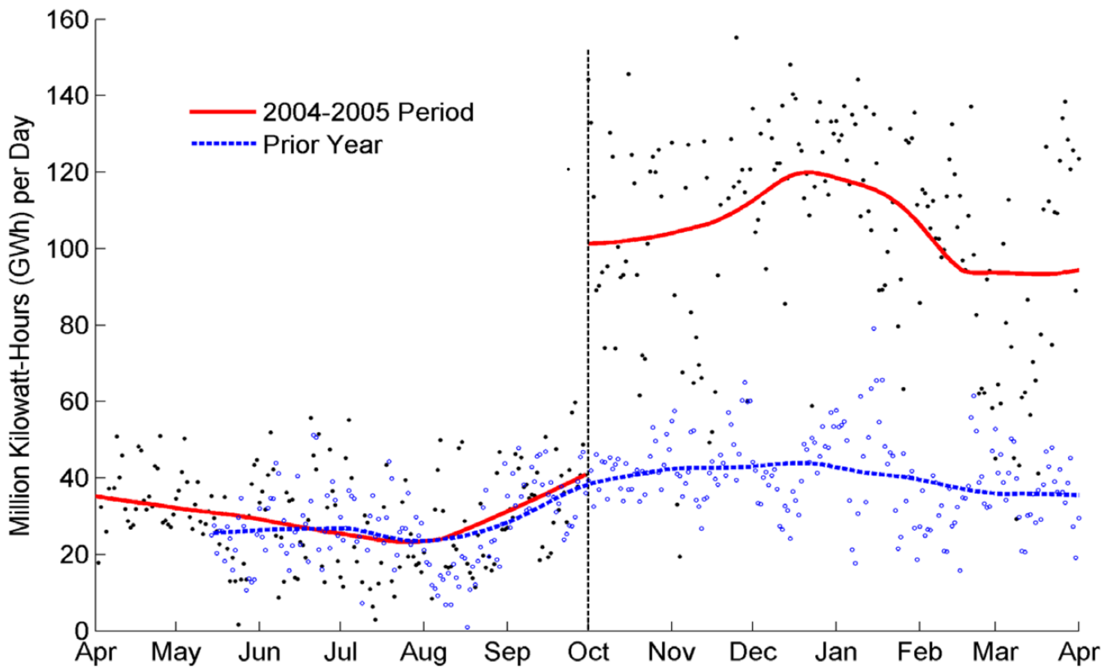

Figure 2: Day-Ahead Net Exports from Midwest to East (PJM)

Figure 1 - From Mansur & White, supra note 8.

"superior information aggregation about congestion externalities."[22]

The second key study is a comprehensive evaluation of the fifteen expansions of centralized markets in the United States from 1999 to 2012.[23] By looking at those fifteen expansions over time using detailed data on power plant operations, the study is able to credibly estimate the overall average effect of centralized markets on the cost of providing electricity. At the end of the sample period, 2012, centralized markets in the United States were responsible for reducing the cost of producing electricity in their footprints by almost $5 billion.[24] That level of cost reduction was equivalent to 5 percent of the total variable costs of producing electricity in

[22] *Id.* at 1.
[23] Cicala (2019), *supra* note 8, at 6.
[24] *Id* at 30.

those markets.[25]

This second study is particularly informative because the methodology allowed the authors to look not only at the total efficiency benefits of centralized markets, but also at the specific components of that efficiency gain. One component is the reduction in generation costs *within* a balancing authority. Generation cost savings are caused by the use of dispatch rules that take advantage of price signals and individual generators' economic incentives in order to more consistently prioritize the use of the least-cost generating options. The study suggests a number of possible means through which the cost savings could occur, including reductions in self-scheduled generation, scheduled maintenance, unscheduled outages, transmission constraints in a balancing authority, the exertion of market power, and start-up costs.[26]

A second component of the efficiency improvements is the gains-from-trade *across* balancing authorities, caused mainly by the grid operator's ability to aggregate and use information on transmission network congestion, and to use a larger pool of resources to meet demand. The study concludes the monetized benefits from both reduced production costs and gains-from-trade are economically and statistically significant.[27]

B. Centralized Electricity Markets Can Increase the Compensation of Variable Resources

In order for Colorado to meet its ambitious climate goals, variable electricity generators (such as wind and solar) must be rapidly deployed and fully utilized.[28] As a result, it is important for the Commission to consider how centralized electricity market constructs are able to better

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[25] *Id.*
[26] *Id*. at 9.
[27] *Id*. at 30. ("The implied impacts [of centralized markets] grow to $1.7B for gains-from-trade and $3.2B in reduced . . . costs").
[28] *See* VIBRANT CLEAN ENERGY, COLORADO ELECTRIFICATION & DECARBONIZATION STUDY (2019), https://www.vibrantcleanenergy.com/wp-content/uploads/2019/11/CEDS-CEI-VCE-FullReport.pdf [hereinafter "Vibrant Study"].

increase the compensation of these resources so that they can be more easily financed. To do this, the Commission should evaluate how each market construct can integrate these resources into reliable electric system operations, compensate them for the full value they provide, and increase the amount of electricity they can sell by reducing unnecessary "curtailments," as the following paragraph detail.

Coordinating conventional electricity generators, like coal and gas plants, to accommodate variable generation from wind and solar can be a challenge because the variability cannot be predicted with perfect accuracy ahead of time. Slower-responding units may not be able to ramp up or down in real-time, and as a result the generation from some resource might be wasted if the output of the variable renewable resources is reduced, or "curtailed." Curtailing zero-marginal-cost renewable resources in favor of inflexible fossil fuel generation wastes resources, increases emissions, and reduces the total compensation renewable resources receive. As a result, the potential for inefficient curtailments reduces the economic incentive for new entry of renewable resources and for retirement of existing fossil fuel resources.

Given the limited prior role of variable resources in the electric power sector, there are few economic studies that have quantified how their compensation might differ in a centralized market. One economic study credibly documents the effect that increased coordination in centralized markets has on the curtailment of wind turbines and finds that such curtailments are reduced.[29] Using the expansion of the Midcontinent Independent System Operator in 2005, the study directly quantifies how the output of a single turbine changes after being incorporated into a centralized energy market. Because of enhanced coordination by the market operator, fossil

[29] See Steve Dahlke*, Effects of Wholesale Electricity Markets on Wind Generation in the Midwestern United States,* 122 ENERGY POLICY 358 (2018). To the best of our knowledge, this is the key study in the existing literature that looks at performance in markets versus utility dispatch by using a quasi-experimental framework based on observed outcomes.

fuel plants were able accommodate the wind generation. By participating in the market, curtailment of wind turbines was reduced and, as a result, output from wind turbines increased by 1.7-2.8 percentage points.[30] Because the costs of joining an existing centralized market are minimal, this increased production from existing wind turbines is a cost-effective way to help propel Colorado towards its clean energy goals.

The technical properties of variable resources can inform researchers of what sorts of market features are necessary for them to be fully integrated into the electric power sector. One result from a comprehensive study of wind and solar in the Western Interconnection is that "balancing area cooperation is essential."[31] Because centralized electricity markets are better at coordinating electricity generators and transmission constraints across balancing authorities, it is straightforward that centralized electricity markets can improve the integration of variable resources and increase their compensation.

Cooperation of balancing authorities provides three benefits that allow for better integration of variable resources: [32]

1. "aggregating diverse renewable resources,"
2. "aggregating the load," and
3. "aggregating the non-renewable balance of generation."

The first two benefits reduce the overall variability in the balance of supply and demand on the electricity grid. By combining the geographic footprints of balancing authorities, a

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[30] *Id*. at 363 (showing that the estimated impact is statistically significant from zero).
[31] *See* GE ENERGY, WESTERN WIND AND SOLAR INTEGRATION STUDY 310 (2010) (prepared for National Renewable Energy Laboratory) [hereinafter "GE Wind Integration Study"].
[32] *See id*. at 311. *See also* Cristina L. Archer & Mark Z. Jacobson, *Supplying Baseload Power and Reducing Transmission Requirements by Interconnecting Wind Farms.* 46 J. APPLIED METEOROLOGY & CLIMATOLOGY 1701 (2007); PAUL DENHOLM & ROBERT MARGOLIS, NAT'L RENEWABLE ENERGY LAB., ENERGY STORAGE REQUIREMENTS FOR ACHIEVING 50% SOLAR PHOTOVOLTAIC ENERGY PENETRATION IN CALIFORNIA 12 (2016), https://www.nrel.gov/docs/fy16osti/66595.pdf.

centralized market can take advantage of a geographically diverse set of variable resources, with different production profiles and located in different time zones, which reduces the variability of their output in the aggregate.[33] A similar effect can occur by aggregating geographically diverse load. As a result of this reduced variability, fewer non-renewable resources are needed to stand by in case there is a sudden decrease in electricity generation. At 10 percent integration of renewable resources, cooperation across the entire Western Interconnection can reduce operating costs by over $2 billion.[34]

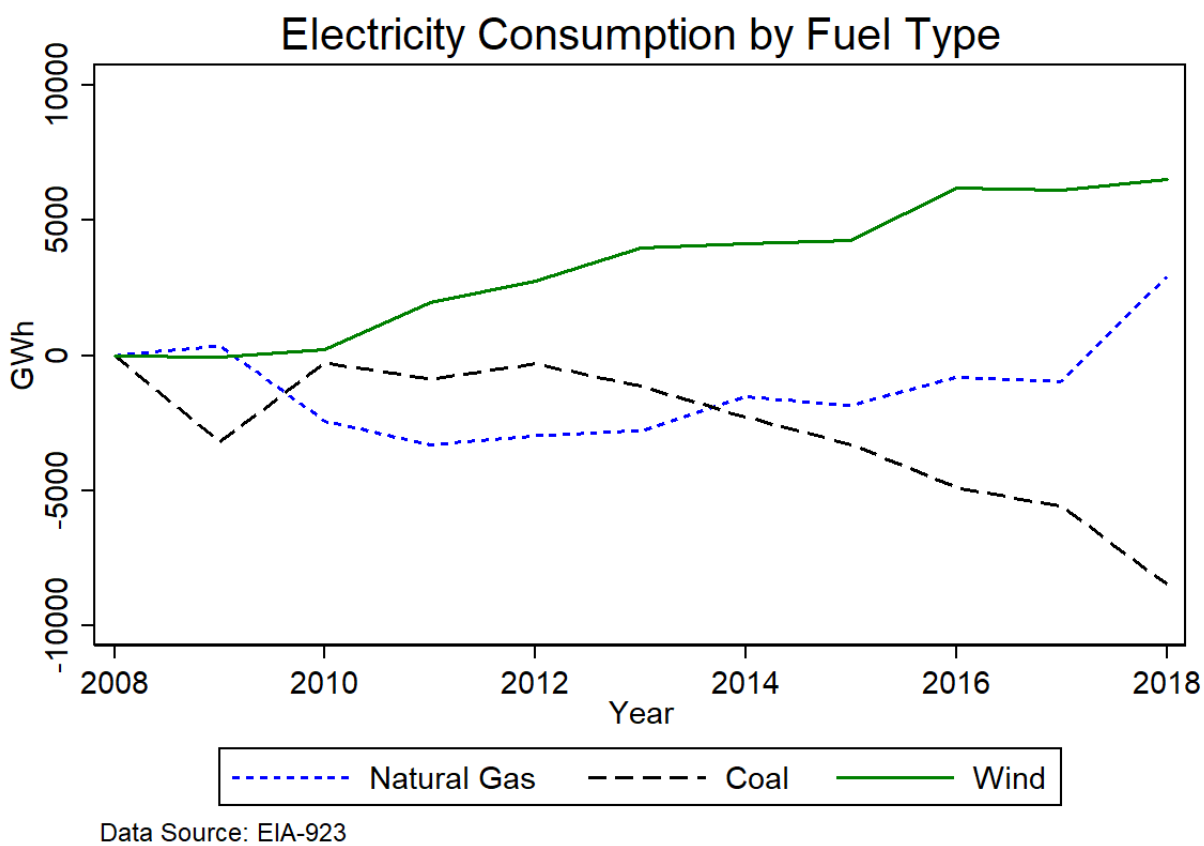
The final benefit of balancing authority cooperation, aggregating non-renewable balance, provides the market operator with more resources to balance the electricity grid. Drawing from a larger pool of resources allows the balance of supply and demand to be met with lower cost electricity generators.

II. Centralized Electricity Markets Are Compatible with Policies to Achieve Colorado's Energy and Environmental Goals

Colorado's electricity system is in the midst of a transition. As shown in the chart below, over the past decade, Colorado has seen a significant decrease in electricity generated from coal, replaced by increased generation from natural gas and renewable energy. Colorado has adopted ambitious clean energy and climate policies that will require a significant acceleration of this transition over the coming decades.[35] In 2019, the state adopted House Bill (HB) 19-1261, which establishes economy-wide greenhouse gas emission reduction goals of 26 percent by 2025, 50 percent by 2030, and 90 percent by 2050.[36] Senate Bill 19-236 requires Public Service to reduce

[33] *See* Archer & Jacobson, *supra* note 32; Denholm & Margolis, *supra* note 32, at 30.
[34] GE Wind Integration Study, *supra* note 31, at ES-16.
[35] *See* CTCA Order at ¶¶ 21-25.
[36] CTCA Order at ¶ 24.

its carbon emissions 80 percent by 2030 and 100 percent by 2050.[37] And Governor Polis has set a goal that by 2040, 100 percent of the electricity consumed in the state come from renewable resources.[38]



Participation in well-designed centralized electricity markets can help accomplish these ambitious climate goals. Because competitive markets provide clear economic incentives to rely on the lowest-cost generators, joining a market can lead to reduced use (and even accelerated retirement) of older, expensive coal-fired generation.[39] As explained in Part I.B above,

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[37] *Id.*
[38] *Id.* at ¶ 23.
[39] *See* Peter Malney, *A Complicated Calculus Keeps the Remaining Coal Fleet Alive*, UTILITY DIVE (Mar. 19, 2018), https://www.utilitydive.com/news/a-complicated-calculus-keeps-the-remaining-coal-fleet-alive/519076/. On the other hand, improvements in production and system efficiency facilitated by competitive markets can increase utilization of existing fossil fuel-fired plants if Colorado joins a regional market and if generators outside of

centralized electricity markets can also provide significant benefits for the integration of renewable energy that reduce in-state greenhouse gas emissions.

However, it is important to note that, such markets have not traditionally been explicitly designed to reduce greenhouse gas emissions. Achieving the state's ambitious goals will not occur through wholesale market participation alone—particularly if those goals require a significant increase in electric demand to reduce greenhouse gas emissions from transportation, heating, and industry through beneficial electrification.[40] As a result, even if Colorado were to join a centralized market, in order for the state to meet its goals, it will have to pair market participation with additional policies. As we explain in this section, such policies can be compatible with centralized market participation, and so Colorado's climate and clean energy goals are a reason to move towards centralized markets rather than a reason to reject the efficiency improvements of markets.

A. If Colorado Joins a Centralized Market, It Should Consider Implementing a Carbon Price to Meet Its Carbon Reduction Goals

While perfectly competitive markets are efficient, when one of the underlying conditions is not met, they can fail to achieve economically efficient outcomes. And, electricity generation suffers from a major and generally unaddressed market failure: externalities due to the emission of greenhouse gases and local air pollutants.

Externalities are costs or benefits of market transactions that are incurred by third parties.

Colorado are more costly. *See* CHARLES RIVER ASSOCIATES, COST-BENEFIT ANALYSIS OF ENTERGY AND CLECO POWER JOINING THE SPP RTO at 21-22 (2010), https://www.ferc.gov/industries/electric/indus-act/rto/spp/spp-entergy-cba-report.pdf. The net effect of markets on GHG emissions will depend on the specific circumstances. For that reason, as explained in Part III, the Commission should explicitly evaluate and monetize GHG emissions effects of different market options. In addition, as explained further here, the Commission should pair market participation with complementary GHG emission reduction and clean energy policies.

[40] *See* Vibrant Study, *supra* note 28 (comparing a BAU scenario assuming least-cost dispatch with a deep decarbonization scenario designed to achieve the GHG emission reduction goals of HB 19-1261).

When there are externalities, private costs will differ from cost to society. And, because economic actors make decisions only based on the private costs they face, their decisions will not consider externalities.[41] As a result, when there are environmental externalities, the market outcomes will not maximize net social benefits.

In the absence of specific policy to address externalities, this market failure would occur in centralized energy markets, just as it does under Colorado's current non-market approach. When emitting resources are not required to pay the full external costs that they impose on third parties, they can submit energy market bids below the actual social marginal cost of their generation. As a result of these inefficiently low bids, emitting resources get dispatched more often and receive more revenue than is socially efficient.

However, this market failure can be remedied by policies that can "internalize" the externality. The solution prescribed by economics to externalities such as greenhouse gas emissions and other air pollution would be to force emitting generators to internalize these damages by making them pay for each ton of emission through a pricing policy.[42] If generators have to pay for the damages in full, their private costs would increase to align with social costs, helping the market restore economic efficiency.

As this section explains, wholesale markets are compatible with state-implemented emissions pricing (i.e., a carbon tax or cap-and-trade program), should the state opt to use such a policy to meet its greenhouse gas reduction goals. Alternatively, emissions pricing could be incorporated directly into the wholesale market pricing mechanism.

If Colorado ultimately opts to meet its greenhouse gas emission reduction goals through a

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[41] *See* KRUGMAN & WELLS, *supra* note 6, at 433-438; *see also* Rudy Perkins, *Electricity Deregulation, Environmental Externalities and the Limitations of Price*, 39 B.C. L. REV. 993, 994 (1998).
[42] *See* A. C. PIGOU, THE ECONOMICS OF WELFARE (1920).

carbon pricing policy, that approach would be compatible with centralized electricity markets. In fact, because dispatch in a centralized market is directly related to a generator's marginal costs rather than command-and-control decisionmaking by a utility subject to cost-of-service regulation, centralized markets and carbon pricing are complementary policies. Faced with a higher marginal cost of electricity generation because it has to pay for the emissions-related damage it causes, the emitting generator would be forced to revise upwards its bids in the energy market, thus likely clearing that market less often. Non-emitting generators would not face additional costs, and so would clear the market more often with their (now) relatively low bids. Over time, carbon pricing would also create incentives for new non-emitting generators to enter the market and for emitting generators to exit. A recent analysis conducted by Resources for the Future found that carbon pricing can be a cost-effective policy tool to meet state clean energy goals.[43]

Long-standing FERC precedent makes clear that emission pricing policies (including taxes and functionally similar cap-and-trade programs) are compatible with wholesale markets.[44] CAISO is currently in the process of evaluating how to incorporate different carbon pricing policies imposed by different states participating in its EIM and future Extended Day-Ahead Market (EDAM).[45] Moreover, when imposed by states, these policies remain within state control; they do not generally become FERC-jurisdictional merely when imposed on utilities

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[43] DANIEL SHAWHAN, PAUL PICCIANO & KAREN PALMER, RESOURCES FOR THE FUTURE, BENEFITS AND COSTS OF POWER PLANT CARBON EMISSIONS PRICING IN NEW YORK (2019), https://pjm.com/-/media/committees-groups/task-forces/cpstf/postings/issue-charge.ashx?la=en.

[44] Cal. Indep. Sys. Operator Corp., 153 FERC ¶ 61,087, P 57 (2015) (providing for generators to take the cost of complying with California's cap-and-trade program into account in the CAISO-administered markets); Nat'l Grid Generation, LLC, 143 FERC ¶ 61,163, PP 5, 12 (2013) (approving inclusion of Regional Greenhouse Gas Initiative allowance costs into bids).

[45] *See* CAL. ISO, EXTENDING THE DAY-AHEAD MARKET TO EIM ENTITIES: ISSUE PAPER 14-16 (October 10, 2019), http://www.caiso.com/Documents/IssuePaper-ExtendedDayAheadMarket.pdf

engaged in FERC-jurisdictional wholesale sales.[46]

A state-imposed carbon price is not the only mechanism to price greenhouse gas emission to correct the market inefficiencies that exist in the energy market. While no wholesale energy market operator currently includes a carbon price in the market; two RTOs are currently considering incorporating the externalities of greenhouse gas emissions into their energy market designs.[47] A number of academic articles have concluded that FERC has authority to approve a tariff that addresses the market distortions in the energy market caused by the inefficient bidding behavior in the presence of externalities.[48] As a result, the Commission should consider the possibility of forming or joining a centralized market that will implement a carbon pricing policy. This type of centralized market would facilitate achievement of the state's greenhouse gas emission reduction and clean energy goals in an efficient manner.

B. Clean Energy Obligations Can Be Compatible With Centralized Markets

Another market-compatible approach to clean energy deployment and emissions reduction is subsidizing clean energy resources through the issuance of credits that must be purchased by load serving electric utilities. While these subsidies may not be as economically efficient as a carbon pricing policy, if well-designed, they can function as a second-best, yet still market-compatible, policy approach to achieving Colorado's greenhouse gas emission reduction

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[46] Edison Elec. Inst., 69 FERC ¶ 61,344 (1994).

[47] *See* PJM, ISSUE CHARGE: CARBON PRICING SENIOR TASK FORCE (2019), https://pjm.com/-/media/committees-groups/task-forces/cpstf/postings/issue-charge.ashx?la=en; N.Y. INDEP. SYS. OPERATOR, CARBON PRICING PROPOSAL RECOMMENDATIONS (Oct. 31, 2018), https://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg_ipptf/meeting_materials/2018-10-29/2018-10-23_IPPTF%20Draft%20Recommendations%20FOR%20POSTING.pdf.

[48] *See* Bethany Davis Noll & Burcin Unel, *Markets, Externalities, and the Federal Power Act*, 27 N.Y.U. ENVTL. L.J. 1 (2019) (evaluating FERC's authority to consider a carbon price in an ISO/RTO market based on its role as an economic regulator of efficient markets); Joel B. Eisen, *FERC's Expansive Authority to Transform the Electric Grid*, 49 U.C. DAVIS L. REV. 1788 (2016); Ari Peskoe, *Easing Jurisdictional Tensions by Integrating Public Policy in Wholesale Electricity Markets*, 38 ENERGY L.J. 1, 2 (2017); Christopher J. Bateman & James T. B. Tripp, *Toward Greener FERC Regulation of the Power Industry*, 38 HARV. ENVTL. L. REV. 275, 329 (2014).

goals.[49] This section explains that such policies are both economically and legally compatible with wholesale markets.

1. Clean Energy Obligations Can Be Designed to Be Economically Compatible with Centralized Markets

One of the primary policy tools that Colorado has adopted to increase deployment of renewable energy and reduce emissions in the electricity system is the Renewable Energy Standard (RES).[50] This approach to clean energy deployment is economically compatible with centralized electricity markets. The primary mechanism by which utilities comply with Colorado's RES is through the procurement and retirement of tradeable renewable energy credits (RECs).[51] RECs separate out—and separately compensate—the renewable and emission-free attributes of generation from wholesale electricity. As a result, utility obligations to purchase RECs ensure that increasing levels of renewable energy are deployed for use within the state without undermining the benefits of competitive wholesale electricity markets. Colorado would not need to make changes to its RES in order to align its primary clean energy deployment policy with a future centralized market construct.

RECs are not the only clean energy procurement option that is market compatible. While Colorado's regulations are currently focused on the increased use of renewable energy, the state might decide to meet its greenhouse gas emission reduction goals using a broader portfolio of clean energy resources. Public Service has recently committed to an 80 percent reduction in greenhouse gas emissions reductions by 2030, and to use 100 percent zero-emission energy by

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[49] For a description of the efficiency effects of state clean energy credit programs designed to achieve greenhouse gas emission reductions, and their relationship with resource adequacy requirements, see generally SYLWIA BIALEK & BURCIN UNEL, CAPACITY MARKETS AND EXTERNALITIES (2018), https://policyintegrity.org/publications/detail/capacity-markets-and-externalities.
[50] Colo. Rev. Stat. § 40-2-124.
[51] Colo. Rev. Stat. § 40-2-124(1)(d), (8)(e).

2050.[52] Public Service anticipates meeting these commitments with RES-eligible resources as well as, potentially, nuclear power and fossil fuel-fired power with carbon capture and sequestration.[53] If the Commission ultimately decides it is in the public interest for electric utilities to meet the state's greenhouse gas emission reduction goals using non-renewable low or zero emission resources, it can do so using policy designs that are compatible with centralized wholesale markets. For example, New York and Illinois have developed zero emission credit (ZEC) programs that provide financial support to nuclear generation.[54] These programs are designed to provide efficient signals for avoiding or reducing electric sector emissions by paying resources for the economic value of avoided greenhouse gas emissions based on the federal Interagency Working Group's Social Cost of Carbon, adjusted based on wholesale market prices.[55] There have also been a number of proposals for technology-neutral clean energy crediting mechanisms designed to be compatible with centralized electricity market constructs.[56]

Credit-based clean energy procurement programs—including Colorado's existing RES as

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[52] Julia Pyper, *Xcel Energy Commits to 100% Carbon-Free Electricity by 2050*, GREENTECHMEDIA (Dec. 4, 2018). https://www.greentechmedia.com/articles/read/xcel-commits-to-100-carbon-free-electricity-by-20501

[53] *Id.*

[54] *See* N.Y. Pub. Serv. Comm'n, Order Adopting a Clean Energy Standard, Case 15-E-0302, Aug. 1, 2016, http://documents.dps.ny.gov/ public/Common/ViewDoc.aspx?DocRef Id={44C5D5B8-14C3-4F32-8399-F5487D6D8FE8}; Ill. S.B. 2814 (Future Energy Jobs Bill), 99th Gen. Assemb., Reg. Sess. (Ill. 2016), at 135–36, http://www.ilga.gov/legislation/99/SB/ PDF/09900SB2814enr.pdf; N.J. Stat. Ann. § C.48:3-87.3.b(8) (West 2018).

[55] *See* Brief of the Institute for Policy Integrity at New York University School of Law as Amicus Curiae in Support of Defendants-Appellees, Coalition for Competitive Electricity v. Zibelman, No. 17-2654 (2d Cir. filed Nov. 27, 2017), https://policyintegrity.org/documents/Coalition_for_Competitive_Electricity_-_Policy_Integrity_Amicus_Brief_As_Filed.pdf (describing efficiency-enhancing features of New York ZEC program).

[56] *See, e.g.* KATHLEEN SPEES ET AL., HOW STATES, CITIES, AND CUSTOMERS CAN HARNESS COMPETITIVE MARKETS TO MEET AMBITIOUS CARBON GOALS: THROUGH A FORWARD MARKET FOR CLEAN ENERGY ATTRIBUTES (2019), https://brattlefiles.blob.core.windows.net/files/17063_how_states_cities_and_customers_can_harness_competitive_markets_to_meet_ambitious_carbon_goals_-_through_a_forward_market_for_clean_energy_attributes.pdf (describing Forward Clean Energy market policy proposal); ROBERT STODDARD, CHARLES RIVER ASSOCIATES, ACHIEVING STATE POLICY GOALS IN MARKETS (2017) (describing Dynamic Clean Energy Market policy proposal), http://necpuc.org/wp-content/uploads/2017/06/Stoddard-Achieving-State-Policy-Goals.pdf. Note that Policy Integrity supports technology neutrality as an important policy design criterion, but does not endorse any particular clean energy procurement market design proposal, the efficiency of which will depend on specific design details.

well as technology neutral clean energy procurement programs—are economically compatible with wholesale markets.

2. Participating in a Centralized Market Would Not Cause Colorado to Lose Legal Authority Over Its Clean Energy Programs

The relationship between federal and state authority over energy policy is governed by the Federal Power Act (FPA).[57] The FPA provides FERC with regulatory authority over wholesale sales of electricity and interstate transmissions service, and reserves to the state authority over the generation and distribution of electricity, and retails sales.[58] As a result, participation of Colorado's electric utilities in a centralized electricity market will subject those resources to the governing rules of those markets and to general FERC oversight of those market rules.

However, it is important to recognize that this does not mean the state will lose authority over its clean energy policies. Under the FPA, states retain authority over the composition of their energy mix, and consequently retain authority to set clean energy goals so long as those goals do not directly regulate wholesale electricity rates or rules directing affecting wholesale rates.[59] FERC has consistently held that unbundled credit programs (such as Colorado's RES) fall outside of FERC's jurisdiction even when resources are participating in FERC-jurisdictional electricity markets.[60]

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[57] 16 U.S.C. 824 et seq.

[58] 16 U.S.C. § 824(b)(1) (FERC "shall not have jurisdiction, except as specifically provided in this subchapter and subchapter III of this chapter, over facilities used for the generation of electric energy or over facilities used in local distribution").

[59] *See Entergy* Nuclear *Vt. Yankee, LLC v. Shumlin*, 733 F.3d 393, 417 (2d Cir. 2013) ("[S]tates have broad powers under state law to direct the planning and resource decisions of utilities under their jurisdiction. States may, for example, order utilities to build renewable generators themselves, or . . . order utilities to purchase renewable generation") (citations omitted).

[60] WSPP Inc., 139 FERC ¶ 61,061 (2012); *See* Brief for the United States and Federal Energy Regulatory Commission as Amici Curiae in Support of Defendants-Respondents and Affirmance at 22, Village of Old Mill Creek v. Star, No. 17-2433 (7th Cir. May 29, 2018), available at

In addition, a number of recent federal court cases make clear that states retain authority to implement energy policy through subsidies, tax incentives, and procurement mechanisms. In *Hughes v. Talen Energy Mktg*., the Supreme Court found that a Maryland program that guaranteed specified payments to certain natural gas generators through a contract for differences replaced the FERC-approved wholesale rate and so was preempted by the FPA.[61] However, the Court clarified that its decision did not implicate "measures States might employ to encourage development of new or clean generation, including tax incentives, land grants, direct subsidies, [and] construction of state-owned generation facilities" so long as those policies were not directly tethered to wholesale market participation.[62]

More recently, two federal courts of appeals cases affirmed that credit-based clean energy procurement similar to Colorado's RES are not preempted by the FPA.[63] Those cases involved challenges to the Illinois and New York nuclear subsidy programs. A coalition of independent power producers argued that because the subsidy provided to nuclear generators was adjusted down based on a rough estimate of the wholesale market revenues the generators would receive, those programs ran afoul of FERC's sole authority over wholesale rates. The courts disagreed, reaffirming the limited nature of the Supreme Court's holding in *Hughes* and clearly stating that states retain authority to set clean energy policies, including credit-based procurement policies, so long as they do not functionally replace the rate that a resource receive for wholesale sales or condition the subsidy on wholesale market participation.[64] The Supreme Court denied

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https://statepowerproject.files.wordpress.com/2018/05/il-7th-us-brief2.pdf (explaining that the limitation on FERC jurisdiction over RECs provides a useful guide for analyzing other state energy policies such as ZECs).

[61] 136 S. Ct. 1288, 1292 (2016).

[62] *Id.* at 1299.

[63] *Coal. for Competitive Elec. v. Zibelman*, 906 F.3d 41 (2d Cir. 2018); Elec. Power Supply Ass'n v. Star, 904 F.3d 518, (7th Cir. 2018).

[64] *Id.* at 50-52.

certiorari.[65]

State clean energy obligations need not take the form of credit-based procurement programs in order to be legally compatible with centralized markets. Courts have rejected challenges to state programs to increase clean energy through bilateral contracts,[66] and FERC has concluded that states have jurisdiction over "resource planning and . . . [and] over utility generation and resource portfolios."[67] While the legal compatibility of such programs will depend on the specific design, Colorado should take comfort in the fact that it need not give up the opportunity to meet its clean energy and climate goals in order to gain the efficiency benefits of centralized wholesale markets.

While tension between FERC-regulated wholesale markets and state policies has received a lot of press and political attention, the primary issues have arisen in a limited number of markets (most significantly, PJM Interconnection) and through disputes about the design of mandatory capacity markets.[68] None of the centralized market constructs under consideration by the Commission would implicate either PJM or capacity markets. FERC recently rejected a complaint that state energy policies were undermining resource adequacy in CAISO.[69] FERC also recently rejected protests to MISO's IRP-focused resource adequacy approach.[70] The Western EIM is designed to rely on existing resource adequacy requirements imposed by the states in which the EIM-participating balancing authorities are located, which have not given rise

[65] *See Elec. Power Supply Ass'n v. Star*, 139 S.Ct. 1547 (2019).
[66]*See* Allco Finance Ltd. v. Klee, 861 F.3d 82 (2d Cir. 2015) (rejecting argument that state program mandating certain bilateral contracts with renewable resources was preempted by the FPA).
[67] FERC Order No. 888, 61 Fed. Reg. 21,540, 21,625 n. 544 (1996).
[68] *See, e.g.* Calpine Corp. v. PJM Interconnection L.L.C., 163 FERC ¶ 61,236 (June 29, 2018).
[69] *See* CXA La Paloma LLC v. Cal. Independent Sys. Operator Corp., 165 FERC ¶ 61,148, at P 76 (Nov. 19, 2018).
[70] *Midcontinent Indep. Transmission Sys. Operator, Inc.*, 162 FERC ¶ 61,176, at P 63 (2018).

to conflicts with state policy.[71] Nor does Southwest Power Pool's Resource Adequacy Requirement include a mandatory capacity market that would undermine state clean energy requirements.[72]

III. The Commission Should Consider Environmental Costs and Benefits When Evaluating Centralized Electricity Market Options

The Commission has requested comment on what costs and benefits beyond "the savings attributable to generation commitment and dispatch optimization provided by integrated markets" it should consider.[73] The Commission's goal in evaluating whether Colorado's electricity system should move to a centralized market structure should be to maximize net social welfare. And in order to ensure that Colorado's participation in a centralized electricity market results in an economically efficient allocation of society's resources, the Commission should analyze each potential market construct using a societal cost-benefit analysis. That is, the Commission should consider not only private costs and benefits to utilities, generators, and ratepayers, but also external costs and benefits to society in general.

A critical component of a societal cost-benefit analysis would be evaluation of external environmental and public health costs and benefits—and in particular those costs and benefits associated with emissions of greenhouse gases and criteria pollutants. Evaluating externality costs and benefits would represent an important addition to the cost-benefit analyses of centralized electricity markets that were already conducted as part of the Commission's

[71] Cal. Indep. Sys. Operator, 147 FERC ¶ 61,231 at PP 122-23 (2014) (accepting CAISO proposal that EIM participants retain their own resource adequacy programs and rejecting request that forward capacity obligations be required for EIM participants).
[72] *See* Southwest Power Pool, Inc., 164 FERC ¶ 61,092 (Aug. 7, 2018).
[73] CTCA Order at ¶ 39(a).

evaluation of Western EIM participation by Colorado electric utilities,[74] and of the Mountain West Transmission Group's investigation into joining the Southwest Power Pool.[75]

As this section explains, the Commission has the legal authority and economic tools to incorporate environmental costs and benefits into its evaluation of centralized electricity market constructs.

A. The Commission Has Authority to Evaluate Environmental Costs and Benefits

In addition to being the most analytically sound way to prioritize policy options, inclusion of environmental costs and benefits in its analysis is consistent with the specific requirements of the CTCA. The Commission can reasonably interpret its current obligation to investigate costs and benefits to utilities and consumers to include full consideration of climate change and other air pollution damages. Alternatively, the Commission should approach its current task in light of the ultimate decision it must make with the information collected in this proceeding, which requires the Commission to determine whether any form of centralized market would be in the "public interest." That public interest determination clearly can include consideration of climate change and local air pollution damages.

Section 40-2.3-102(1) of the CTCA directs the Commission to open a docket to "investigate the potential costs and benefits to electric utilities, other generators, and Colorado electric utility customers."[76] Air pollution externalities play an important role in the costs and

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[74] M MILLIGAN ET AL., NAT'L RENEWABLE ENERGY LAB., EXAMINATION OF POTENTIAL BENEFITS OF AN ENERGY IMBALANCE MARKET IN THE WESTERN INTERCONNECTION 57 (2013), https://www.nrel.gov/docs/fy13osti/57115.pdf (quantifying changes in air pollution emissions due in a Western EIM but failing to monetize the damages associated with such emissions).

[75] *See* SOUTHWEST POWER POOL, 10-YEAR COSTS AND BENEFITS TO SPP MEMBERS OF INTEGRATING MOUNTAIN WEST TRANSMISSION GROUP: QUANTITATIVE ANALYSIS OF COSTS AND BENEFITS (March 19, 2018), https://www.spp.org/documents/56652/mwtg%20cba%20report%20for%20spp%20members%20mar-19-2018.pdf (failing to discuss or estimate environmental costs and benefits of Southwest Power Pool membership).

[76] Colo. Rev. Stat. § 40-2.3-102(1).

benefits faced by utility customers. Reduction in conventional air pollution directly benefits Colorado consumers by reducing public health damages from emission of those pollutants. Conventional air pollution generally affects people close to where the pollutants are emitted. As a result, conventional air pollution emitted within the state will largely cause harm to Colorado residents.[77]

Reductions in greenhouse gases also benefit Colorado electric consumers. Some portion of the climate change damages caused by greenhouse gas emissions will directly affect Colorado consumers and businesses, including (but by no means limited to):

- human health impacts, including cardiovascular and respiratory mortality from heat-related illnesses;[78]
- changes in energy demand, from temperature-related changes to the demand for cooling and heating;[79]
- lost productivity and other impacts to agriculture and forestry due to alterations in temperature, precipitation, CO2 fertilization, and other climate effects;
- increased frequency and severity of dangerous wildfires;[80]
- impacts to outdoor recreation and other non-market amenities.[81]

Some portion of the climate damage of each ton of greenhouse gases emitted in Colorado will occur outside of Colorado. But greenhouse gases emitted outside Colorado also contribute to climate damages in Colorado. And Colorado stands to benefit greatly as other U.S. states and

[77] Of course, not all of Colorado's load is currently served by resources located within Colorado and some portion of the pollution emitted by generators on the Colorado border may affect customers in neighboring states. *See* Tri-State, *What We Do,* https://www.tristategt.org/what-we-do (last accessed Nov. 13, 2019). However, Colorado's participation in a centralized market can also cause reduced utilization of out-of-state generators that deposit conventional pollution on Colorado's customers.

[78] U.S. GLOBAL CHANGE RESEARCH PROGRAM, CLIMATE SCIENCE SPECIAL REPORT: FOURTH NATIONAL CLIMATE ASSESSMENT (2017), https://www.globalchange.gov/browse/reports/climate-science-special-report-fourth-national-climate-assessment-nca4-volume-i.

[79] *Id.*

[80] Z. Liu et al., *Climate Change and Wildfire Risk in an Expanding Wildland–Urban Interface: A Case Study from the Colorado Front Range Corridor*, 30 LANDSCAPE ECOLOGY 1943 (2015).

[81] See R. STEIGER ET AL., A CRITICAL REVIEW OF CLIMATE CHANGE RISK FOR SKI TOURISM. CURRENT ISSUES IN TOURISM, 1-37 (2017); C. Wobus et al., *Projected Climate Change Impacts on Skiing and Snowmobiling: A Case Study of the United States*, 45 GLOBAL ENVIRONMENTAL CHANGE 1 (2017).

other countries apply a global social cost of greenhouse gas value to their regulatory decisions and so weigh the externalities of their emissions that will fall on Colorado. By considering the full externality value of greenhouse gas emissions, Colorado can encourage reciprocal actions by other states and countries. This, in turn, will benefit Colorado and its consumers by reducing the harm of climate change within the state.[82]

Even if the Commission decides that externality costs do not fully affect Colorado utilities and consumers, the Commission nonetheless has authority to evaluate those externality costs in this proceeding. The purpose of this initial evaluative proceeding is to inform later decisionmaking by the Commission, and the evidence collected here should be sufficient to inform whatever ultimate decision the Commission makes. The Commission should, therefore, consider all costs and benefits necessary to fulfill the Commission's later duty under sections 40-2.3-102(3), and 40-2.3-102(4).

Section 40-2.3-102(3) of the CTCA tasks the Commission with issuing a decision that determines whether a competitive wholesale market construct would be in the "public interest."[83] Section 40-2.3-102(4) then directs the Commission to "direct electric utilities to take appropriate actions" in light of the Commission's public interest determination.[84] Therefore, the costs and benefits that the PUC should consider in its initial evaluation should include all costs and benefits necessary to evaluate the public interest.

Under Colorado law, the Commission's evaluation of the "public interest" includes an evaluation of the environmental consequences of an action. For example, section 40-2-125.5 of

[82] For additional detail on the extent to which reciprocity will create value for Colorado consumers, *see* Comments from the Institute for Policy Integrity on the Social Cost of Greenhouse Gases at 4-5 (2019), https://policyintegrity.org/documents/Electric_Rule_NOPR_Initial_Comments_on_SCC_2019.3.29.pdf.
[83] Colo. Rev. Stat. § 40-2.3-102(2).
[84] Colo. Rev. Stat. § 40-2.3-102(3).

Colorado Utility Law requires the Commission to consider whether a utility's clean energy plan is "in the public interest."[85] In listing the factors that the Commission is directed to consider in such a public interest determination, the statue includes "reductions in carbon dioxide and other emissions that will be achieved . . . and the environmental and health benefits of those reductions."[86] The Commission itself has long considered air pollution to be an important component of determining whether a particular electric utility-related decision is in the public interest.[87] Recently, the Commission pointed to its "broad authority to regulate public utilities in this state" when it found it had authority to consider the social cost of greenhouse gas emissions in its evaluation of Public Service Company's proposed Energy Resource Plan.[88] Building on this regulatory precedent, the Commission should embrace a similarly broad interpretation of its authority here and require inclusion of the social costs and benefits—including those imposed by greenhouse gas and other air pollutant emissions—in its CTCA-mandated evaluation of centralized electricity market options.

B. The Commission Should Monetize Environmental Costs and Benefits

The Commission requests comment on which costs and benefits should be quantified,[89] and on how to incorporate environmental goals into its analysis.[90] For environmental costs and benefits, the answers are related: costs and benefits should be quantified, monetized, and then

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[85] Colo. Rev. Stat. § 40-2-125.5(d).
[86] *Id.*
[87] Interim Decision, Decision No. 28815, In the Matter of the Application of Pub. Serv. Co. of Colorado, , , 1976 WL 357867 (Apr. 30, 1976) ("today the public interest dictates consideration not only of the need for electricity to meet growth and demand at reasonable utility rates, but also the need to recognize pollution of the environment in meeting those demands for energy"); Final Order Addressing Emission Reduction Plan, Decision No. C.10-1328 at PP 115-16, In Re Pub. Serv. Co. of Colorado, Proceeding No. 10M-245E (Dec. 15, 2010) (finding conversion of Arapahoe 4 from coal-fired to natural gas generation to be in the public interest *because it will reduce emissions*).
[88] Decision No. C17-0316 at 30, In the Matter of the Application of Public Service Company of Colorado for Approval of its 2016 Electric Resource Plan, Proceeding No. 16A-0396E (2017), https://www.dora.state.co.us/pls/efi/efi_p2_v2_demo.show_ document?p_dms_document_id=863402
[89] CTCA Order at ¶ 39(a).
[90] *Id.* at ¶ 39(k).

compared directly with other monetized costs and benefits. Monetizing emissions facilitates comparison against other costs and benefits. Without such values, decisionmakers are faced with imperfect information; by contrast, when consequences are translated into the common metric of money, decisionmakers can more readily compare society's preferences for competing priorities. If an analysis only qualitatively discusses the externalities of emissions, decisionmakers and the public will both tend to overly discount the significance of the effects. In general, non-monetized effects are often irrationally treated as worthless.[91] This may be especially true with respect to climate change. As the Environmental Protection Agency's website explains, "abstract measurements" of so many tons of greenhouse gases can be rather inscrutable for the public, unless "translat[ed] . . . into concrete terms you can understand."[92] Such context is helpful to the Commission not only in making a decision regarding competitive markets, but also in explaining the chosen decision to Colorado ratepayers and citizens. For example, as explained below, the Social Cost of Greenhouse Gases is an economic measure of climate damages that will allow the Commission to highlight the monetized benefits of a less emission-intensive resource mix facilitated by wholesale market participation, helping the public understand the climate consequences of the decision.

C. Tools Are Available to Estimate and Monetize Environmental Costs and Benefits

The Commission requests comment on what modeling efforts or other analyses the commission should be pursuing.[93] Tools are readily available to evaluate the environmental costs and benefits of wholesale market formation. A number of electricity market models are available

[91] Richard Revesz, *Quantifying Regulatory Benefits*, 102 CAL. L. REV. 1424, 1434-35, 1442 (2014)
[92] EPA, Greenhouse Gas Equivalencies Calculator, https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator (last updated Sept. 2017).
[93] CTCA Order at ¶ 39(e).

that will simulate how particular market constructs will affect investment in and retirement of generation and transmission resources, electric system operational changes, and market prices.[94] Combined with data on emission rates of generators, these models can be used to assess the extent to which different wholesale market options will change overall air pollution and greenhouse gas emissions. For example, the Energy Information Agency has developed a comprehensive open source computer simulation model of the electric system, the National Energy Modeling System ("NEMS"), which has been used to evaluate the costs and benefits of wholesale markets.[95] NEMS incorporates air pollution emissions of modeled resources into the available model outputs.[96]

Tools are available to translate modeled emission changes that would result from a particular market construct into monetized damage estimates. For greenhouse gases, the Social Cost of Carbon is a widely accepted tool developed by the federal Interagency Working Group on the Social Cost of Greenhouse Gases ("IWG")[97] to estimate the net-present value of climate damage caused by the emission of greenhouse gases.[98] The Commission is already considering

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[94] *See* JOSEPH H. ETO & DOUGLAS R. HALE, A REVIEW OF RECENT RTO BENEFIT-COST STUDIES: TOWARD MORE COMPREHENSIVE ASSESSMENTS OF FERC ELECTRICITY RESTRUCTURING POLICIES 27 (2005), http://eta-publications.lbl.gov/sites/default/files/lbnl-58027.pdf (identifying 11 cost-benefit studies of RTO formation and the models that were used, including GE-MAPS, IPM, ZPM, POEMS, Promod-IV, and Marketsym); *see also* SUSAN F. TIERNEY & EDWARD KAHN, A COST-BENEFIT ANALYSIS OF THE NEW YORK INDEPENDENT SYSTEM OPERATOR: THE INITIAL YEARS 10-16 (2007), https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.115.669&rep=rep1&type=pdf. More recent models include SWITCH, *available at* http://switch-model.org/; RPM, *available at* https://www.nrel.gov/analysis/models-rpm.html; ReEEDS, *available at* https://www.nrel.gov/analysis/reeds/; and WIS:dom., *available at* https://www.vibrantcleanenergy.com/products/wisdomp-optimization-tool/.

[95] EIA, AN ANALYSIS OF FERC'S FINAL ENVIRONMENTAL IMPACT STATEMENT FOR ELECTRICITY OPEN ACCESS AND RECOVERY OF STRANDED COSTS (1996), https://www.eia.gov/analysis/requests/archive/1996/oiaf9603.pdf.

[96] EIA, THE NATIONAL ENERGY MODELING SYSTEM: AN OVERVIEW 2009 at 43 (2009), https://www.eia.gov/outlooks/aeo/nems/overview/pdf/0581(2009).pdf.

[97] The IWG, a collection of 13 federal agencies and White House offices, first developed the Social Cost of Carbon in 2010 and updated the estimate in 2013 and 2015. *See* NAT'L RESEARCH COUNCIL, ASSESSMENT OF APPROACHES TO UPDATING THE SOCIAL COST OF CARBON: PHASE 1 REPORT ON A NEAR-TERM UPDATE 6 (2016), https://www.nap.edu/catalog/21898/assessment-of-approaches-to-updating-the-social-cost-of-carbon.

[98] INTERAGENCY WORKING GRP. ON SOCIAL COST OF GREENHOUSE GASES, TECHNICAL SUPPORT DOCUMENT (2016), https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/scc_tsd_final_clean_8_26_16.pdf.

use of the IWG estimates of the social cost of greenhouse gases,[99] which has also been repeatedly endorsed by government reviewers, courts, and experts including the National Academy of Sciences.[100] For conventional air pollutants, sophisticated but accessible models can be used to estimate and monetize location-specific health and agricultural damages of sulfur dioxide, nitrous oxides, and particulate matter emissions.[101]

Given the availability of tools to assess environmental consequences of wholesale markets, the Commission should require that any quantitative analysis of CTCA options includes the costs and benefits of changes in greenhouse gas and conventional pollutant emissions.

IV. Conclusion

Centralized electricity markets provide a number of important benefits, including increasing the efficiency of electricity dispatch and facilitating integration of variable renewable energy. While the state will likely require additional policies beyond merely joining a centralized electricity market in order to meet its climate and clean energy goals, a number of climate and clean energy policies—including carbon pricing policy and the current Renewable Energy Standard—are technically and legally compatible with centralized market constructs. Finally, the Commission should require that any analysis of different market constructs use available tools to quantify and monetize environmental costs and benefits so that the Commission can incorporate those costs and benefits into its determinations under the CTCA.

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[99] *See* In the Matter of the Proposed Amendments to Rules Regulating Electric Utilities, Proceeding No. 19R-009E (2019).

[100] *See* U.S. GOV'T ACCOUNTABILITY OFF., GAO-14-663, REGULATORY IMPACT ANALYSIS: DEVELOPMENT OF SOCIAL COST OF CARBON ESTIMATES 12-19 (2014), https://www.gao.gov/products/GAO-14-663; Zero Zone, Inc. v. Dep't of Energy, 832 F.3d 654, 677-79 (7th Cir. 2016); NAT'L RESEARCH COUNCIL, VALUING CLIMATE DAMAGES: UPDATING ESTIMATION OF THE SOCIAL COST OF CARBON DIOXIDE 3 (2017), https://www.nap.edu/catalog/24651/valuing-climate-damages-updating-estimation-of-the-social-cost-of; NAT'L RESEARCH COUNCIL, *supra* note 97, at 6.

[101] *See* JEFFREY SHRADER, BURCIN UNEL & AVI ZEVIN, VALUING POLLUTION REDUCTIONS: HOW TO MONETIZE GREENHOUSE GAS AND LOCAL AIR POLLUTANT REDUCTIONS FROM DISTRIBUTED ENERGY RESOURCES 22-24 (2018), https://policyintegrity.org/publications/detail/valuing-pollution-reductions.

Respectfully submitted this 15th day of November, 2019.

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