A Strategy and Six Ways to Address Community Energy Goals

Cities and businesses with renewable energy goals need a way to reach them

INTRODUCTION AND PURPOSE

Many Colorado cities have ambitious energy goals but no practical and cost-effective way to reach them. Over one million Coloradans live in cities with the goal of obtaining 100% of their electricity from renewable energy sources. Many large companies also have aggressive renewable energy goals. This paper reviews six possible solutions that would allow cities and large companies to reach their energy goals. Each approach requires state-level legislative and regulatory action.

This paper also suggests a process to move forward. Change requires that decision-makers at the state level (Legislators, Public Utilities Commissioners, and/or the Governor) initiate a process to evaluate the options, identify the best approach, and then bring it into existence. To be widely accepted, the process must be transparent and must invite input from a broad variety of stakeholders, including cities with energy goals, business interests, environmental and consumer advocates, utilities, independent power producers and marketers, and the general public.

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The primary intent of this paper is to provide city leaders, lawmakers, regulators, large energy users, and stakeholders of all types with background information on six possible ways that communities could exercise more choice and control over the energy sources used to produce their electricity. The six approaches focus on cities and companies that are served by investor-owned utilities (IOUs); however, options are also described for those served by electric cooperatives ("co-ops") and municipal electric utilities.

Readers who are less interested in the details of the six approaches are invited to read only the Executive Summary and Conclusions sections, or download the one-page brief. Those who wish to dig deeper are provided with an extensive reference list.

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1. EXECUTIVE SUMMARY

This paper reviews six possible ways that communities could address ambitious renewable energy goals, some of which also apply to large businesses with energy or sustainability goals. The paper recommends a public stakeholder process, led by state level decision-makers, to evaluate the options and determine the best solution(s).

A growing list of Colorado communities have committed to obtaining 100% of their electricity from renewable energy sources – solar, wind, hydro, geothermal – including (as of this writing): Denver; Pueblo; Pueblo County; Boulder; Fort Collins; Lafayette; Longmont; Breckenridge; Summit County; Nederland; and Aspen **[1]**. Denver's goal of 100% renewable energy** by 2030 **[2,3]** is an interim goal of its Climate Action Plan to achieve an 80% reduction in greenhouse gas emissions by 2050 **[4]**. Active campaigns in Colorado that may lead to additional such commitments in the future include: Jefferson County; several Metro Denver cities; Durango; Grand Junction; Manitou Springs; and others. Many large companies, some with a Colorado presence, also have 100% renewable energy goals **[5]**.

The problem:
Over one million Coloradans live in cities or counties with ambitious near-term energy goals, but there is currently no practical way to reach those goals because they have little choice or control over the energy sources used to produce their electricity. These communities, as well as businesses with energy or sustainability goals, deserve a solution that is timely and cost-effective.

The solution:
Six possible approaches are reviewed that would each provide communities with some form of choice or control over the energy sources used to produce their electricity. Each approach requires either modest or major legislative and regulatory action by state level decision-makers.

The recommended approach:
This paper does not advocate for any particular solution, but rather calls for an inclusive and transparent public process to evaluate all of the options – led by state level decision-makers, informed by a broad variety of stakeholders, and focused on arriving at well-informed conclusions that will be widely accepted.

The role of decision-makers:
Legislators, PUC Commissioners, and the Governor must first recognize that a large number of their constituents want and deserve the ability to reach their energy goals, and that a state-level solution is required. Leadership is needed to initiate a process of evaluating the options to arrive at a well-informed conclusion, and then bring the best solution(s) into existence. Examples of such a process include: a Legislative interim

** *The term "100% renewable energy" in this paper refers to electricity only, not to all uses of energy including transportation and heating, unless otherwise stated.*

committee with expert testimony and public hearings; an "I-docket" or "M-docket" at the PUC with invited speakers and public hearings; and/or a "Governor's select committee on community and corporate energy options," also with public input.

The role of stakeholders:
Groups representing business interests, environmental and consumer advocates, large energy users, utilities, communities with energy goals, and community groups like Colorado Communities for Climate Action (CC4CA) **[6]** can approach and lobby decision-makers to initiate this process, and then weigh in on it. A grassroots educational component is also needed to raise awareness of the issue in op-eds, public meetings, city councils, town halls, etc. Sustained public support for finding a way that communities and businesses can reach their energy goals is too compelling of a request for decision-makers to ignore. Communities and large corporate energy users are natural allies that could coordinate their efforts for greater impact.

Six ways to address community energy goals:
The six approaches summarized below are described in greater depth in Section 3 of this paper. The intent of the paper is to provide decision-makers and stakeholders with sufficient information and references to comfortably initiate a public process to evaluate the options; the intent is not to provide an exhaustive treatment of each approach.

- **Community Choice Aggregation (CCA)**: CCA legislation allows cities, counties or other jurisdictions to combine their purchasing power and choose an alternative electricity supplier on behalf of the residents, businesses, and municipal facilities in the jurisdiction. The electricity is still delivered by the incumbent IOU, which continues to own and operate its transmission and distribution system (the "poles and wires"). Individual customers can opt out of the community's choice if they wish, and purchase their electricity from the IOU (in California) or from the IOU or any approved alternative supplier (in other CCA states).
- **Community Choice in Illinois**: Illinois is a "restructured state" with a fully competitive retail electricity market, unlike Colorado or California. In Illinois, producing and selling electricity is a competitive business, separate from the utility's business of delivering electricity from any competitive supplier to end-use customers. Utilities don't own any electricity generation, so there is little tension between the utility and alternative electricity suppliers because they are not in competition. Communities can simply choose between many electricity suppliers that offer different rates, energy mixes, contract lengths, etc.
- **Community Energy Act (HB18-1428)**: This bill, which reflects growing interest in community choice, did not pass the Colorado Senate in 2018; however, it would have allowed communities and IOUs to enter into any collaborative agreement that: 1) is mutually agreed upon; 2) is approved by the PUC; 3) ensures that additional costs to the utility are paid by the community; and 4) does not shift costs to other customers. However, improvements to this first effort are suggested, and should be considered for any similar bill in the future.

- **Municipalization**: Any city served by an IOU can choose to create its own municipal electric utility by acquiring (buying out) and operating the electricity distribution system of the IOU, either at an agreed price or by condemning the assets and paying their fair market value as determined by a court. A municipal utility has the freedom to choose its own electricity supply, energy programs, rate design, and more.
- **Utility-provided 100% renewable energy for everyone**: A variety of studies and other evidence are presented that suggests it is both technically and economically feasible for utilities to accelerate the transition of their entire system to renewable energy, thereby eliminating the need for individual cities to pursue their own solution.
- **Green tariffs**: These are optional programs that allow large commercial and industrial energy users in some monopoly electricity markets to buy renewable electricity from a specific project through the utility. Colorado cities with renewable energy goals could also be characterized as large energy users in a monopoly state looking for cost-effective renewable energy choices, which suggests the idea of designing something like a green tariff that is available to cities or counties.

Options for electric co-ops and municipal electric utilities:
Unlike IOUs, electric distribution co-ops and municipal electric utilities are democratic, self-governing, not-for-profit entities that are mostly not regulated by the PUC. However, most co-ops in Colorado have even less control over their energy sources than cities served by monopoly IOUs, due to the terms of their wholesale electricity contracts. Nonetheless, several co-ops have found ways to pursue their energy goals anyway, which include:

- Buying out their contract and choosing a different wholesale electricity supplier.
- Using a Federal law called PURPA to develop local renewable energy beyond their contractual limit.
- Challenging their wholesale supplier to raise current limits on local electricity generation.

Municipal utilities, which purchase and/or produce their own electricity, have more freedom than co-ops to choose their energy sources, subject mainly to their leadership's support for the community's energy goals.

The time is right to pursue community and corporate electricity options, because:

- A large and growing number of Colorado cities and businesses have ambitious renewable energy goals – this is too large of a constituency to be ignored.
- Cities and businesses want lower cost electricity. Renewable energy and energy storage are reaching cost parity with the operating costs alone of existing fossil fuel plants **[7,8,9,10]**. The economic argument for more renewable energy has become viable and is gaining strength.

- Corporations want to contract directly for low-cost renewable energy **[11]**. States without corporate choice options may have difficulty attracting and keeping energy intensive businesses **[12]**.
- Legislation to address community energy goals was proposed in 2018 (HB18-1428), but did not pass. If a revised bill is introduced in a future session, the time is right to suggest improvements.
- A study by the Edison Electric Institute (the electric utility trade group) finds that renewable energy is extremely popular with the public, and utility opposition to ambitious renewable energy goals is perceived by the public as "excuses" **[13]**. Consumers are in a better position than ever before to ask for what they want from their utilities, and forward-looking utilities will want to stay ahead of this customer demand.

2. HOW COLORADANS GET THEIR ELECTRICITY: THE THREE UTILITY TYPES

The amount of control a community has over the energy sources used to produce their electricity, and which of the six ways of increasing community electricity choice are relevant for them, depends to a large extent on which of the three types of utility serves the community: an investor-owned utility (IOU); an electric cooperative ("co-op"); or a municipal electric utility (also called "public power") **[14]**.

Colorado's two IOUs – Xcel Energy and Black Hills Energy

Colorado's IOUs are "vertically-integrated monopolies." They are for-profit companies that have been granted monopoly control over both the supply of electricity (its generation or wholesale purchase) and the delivery of electricity (over their high-voltage transmission lines and their local distribution network), for all customers in their territory. Together, the IOUs accounted for 57% of the state's 2015 electricity sales (53% for Xcel, and 4% for Black Hills).

IOUs are regulated by the Public Utilities Commission (PUC), which is charged with being fair to utilities while protecting their captive customers from the potential abuses of monopoly power. Utility planning and procurement of generation, transmission and distribution assets is overseen by the PUC. The PUC sets retail electricity rates at a level that allows the IOU to recover their operating costs plus a profit of approximately 10% on any capital investments they make in generation, transmission or distribution infrastructure.

Oversight of IOUs is required because this "cost of service" (or "cost plus") business model incentivizes IOUs to choose building infrastructure as the preferred solution for any need on the electricity system, as opposed to "non-wires alternatives" or customer-owned distributed generation that might be more cost-effective for ratepayers. This "perverse incentive" of the cost-of-service utility model represents a misalignment between the interests of ratepayers and the interests of utility shareholders. Another misaligned incentive concerns the policy of treating fuel costs as a "pass through" cost to consumers with no impact on IOU profitability, and therefore there is no incentive for IOUs to consider fuel costs when choosing generation sources.

Since special treatment of any customer in an IOU's service territory is typically not allowed, everyone in Xcel's territory receives the same energy mix at the same price as everyone else in the same customer class. While this prevents "cost shifts" within a customer class, the required uniformity also makes it difficult to find solutions for cities or businesses that want to pursue their own specific energy goals.

Colorado's 22 electric co-ops [15]

Electric co-ops are non-profit organizations that build, maintain and operate the local electricity distribution system on behalf of the customers in their territory, who are both members and owners of the co-op. Co-ops are managed by an elected Board,

and purchases its electricity from a wholesale supplier, which for 18 of Colorado's 22 distribution co-ops is Tri-State Generation and Transmission Association. Tri-State is itself a "co-op of co-ops," providing wholesale electricity and transmission service to its 43 member distribution co-ops in Colorado, New Mexico, Wyoming and Nebraska. Collectively, Colorado's 22 co-ops accounted for 27% of the state's 2015 electricity sales (18% served by Tri-State, and 9% served by all other wholesale suppliers).

As non-profits, co-ops are only minimally regulated by the PUC. Each distribution co-op sets its retail rate at a level needed to cover the costs of operating the distribution system and buying the wholesale electricity. The co-op, and therefore the individuals and cities that are members of it, have little choice about the energy sources used to produce their electricity or its cost, because contracts are typically very long (40-50 years) and wholesale electricity rates are not regulated by the PUC. Tri-State supply contracts prohibit member co-ops from generating more than 5% of their own electricity locally, but co-ops do have a few options for increasing local control over their energy sources, as described in Section 4.

Colorado's 29 municipal electric utilities [16]

Many cities own and operate their city's electric distribution system. Municipal utilities are non-profits and therefore are not regulated by the PUC. They set retail rates as needed to cover the cost of operations plus wholesale electricity. All of Colorado's municipal electric utilities accounted for 15% of the state's 2015 electricity sales (8% for Colorado Springs, and 7% for all others).

Most municipal utilities purchase their electricity under contracts from a wholesale electricity supplier, but some, like Colorado Springs, or the Platte River Power Authority that serves Fort Collins, Loveland, Longmont and Estes Park, own generation and produce a substantial amount of their own electricity. Municipal utilities are governed by a City Council or an appointed or elected Board, and they can choose their electricity sources and providers to a greater or lesser extent depending on the terms of their wholesale electricity contracts. Unlike co-ops, customers don't have an ownership stake in their utility.

The six approaches for increasing community electricity choice and control that are described in Section 3 are more relevant for cities served by IOUs than for cities served by co-ops or municipal utilities. IOUs are regulated to protect consumers from for-profit entities that have monopoly status, whereas co-ops and municipal utilities are non-profit entities run by democratic local governments. Theoretically, co-ops and municipal utilities could have the freedom to choose their electricity supply, but in practice, choice can be elusive. In many ways, cities served by Tri-State have less ability to pursue their energy goals than cities served by Xcel or Black Hills. Section 4 will review examples of co-ops taking more charge of their energy choices despite their contracts, and examples of municipal utilities moving forward on their ambitious energy goals.

3. SIX WAYS THAT CITIES COULD REACH THEIR ENERGY GOALS

This section reviews six possible ways that communities could obtain more control over their energy sources. Utilities face a choice between cooperating with cities (and large businesses) that want to pursue ambitious energy goals, or obstructing them when utility profits and control are threatened by decreasing electricity consumption and increasing local self-generation **[17]**. The utility trade group, Edison Electric Institute (EEI), has recognized that public opinion hardens against utilities when they give "excuses" about why cities can't have 100% renewable energy any time soon **[13]**. The EEI report also reveals that customers have more leverage than ever before to demand that utilities give them what they want.

The detailed information in this section is intended to provide decision-makers and stakeholders with sufficient background to design an effective process for evaluating possible ways to address community energy goals. The resulting stakeholder process should be thorough, inclusive and transparent so that there is broad buy-in on whatever the best approach turns out to be. Most (but not all) of the approaches would require substantial regulatory and/or legislative action.

3.1 Community Choice Aggregation (CCA)

Eight states – California, Illinois, Massachusetts, New Jersey, New York, Ohio, Rhode Island, and Virginia – have enacted legislation that allows cities, counties or other jurisdictions to combine ("aggregate") individual customer purchasing power and choose an alternative electricity supplier on behalf of the residents, businesses, and municipal facilities in the jurisdiction **[18]**. The electricity is still delivered by the IOU that owns and operates the local distribution network ("poles and wires").

Communities in CCA states might choose to procure their electricity from an alternative supplier for one or more of the following reasons:

- Providing cheaper electricity
- Increasing renewable energy content
- Establishing a new revenue stream to support local energy programs
- Creating more local jobs
- Keeping more energy dollars circulating locally

With the trend of decreasing renewable energy costs expected to continue, the cheapest energy and the cleanest energy are, or soon will be, one and the same **[19,20]**.

The non-profit group, LEAN Energy US **[21],** operates an informative website that describes how CCA works, its history and status in the 8 states, differences between states, and key enabling legislation in each state **[22]**.

The first state to enact CCA legislation was Massachusetts in 1997, and the most recent was Virginia in 2018; however, there is much variability between states in how long it took to form the first operational CCA after it was enacted. The first CCA in New York began operating in 2015, and interest in CCAs has been increasing rapidly **[23]**. In New Jersey, 53 municipalities had contracted with an alternative supplier as of January 2017. In Illinois, a high point of 720 communities with alternative suppliers was reached in 2014, but that number declined after incumbent IOUs lowered their rates to be more competitive, stabilizing at about 570 communities with alternative suppliers in October 2017. California's first CCA began operation in 2010, and interest in CCAs there has been expanding rapidly since 2014 **[24]**.

CCAs are typically vetted and permitted by the state as a consumer protection measure, and states continue to adapt and improve their consumer protections. Each state has different rules governing CCAs. It is a distinct advantage that any new state considering CCA legislation will have a rich history of "lessons learned" and "best practices" from the pioneer states to draw upon.

The New Jersey experience points to an essential characteristic of successful CCA design: it should be opt-out rather than opt-in. Only when all customers are automatically enrolled, except those who later choose to opt out, can a CCA reach high enough adoption to attract competitive suppliers. Uptake under New Jersey's original opt-in system was low until it was changed to an opt-out system in 2012 (although, commercial and municipal accounts must still opt in). The reason opt-in doesn't work is clear and makes sense. Most individuals will simply stay with the default incumbent utility rather than devote the time and effort to learn how choice works and do their own research (inertia is a powerful thing!). However, unlike an individual, a community has the staff to undertake due diligence and make the best choice of a supplier that furthers the community's goals. Most CCAs in California have opt-out rates below 3%, confirming that individuals don't object to community choice, they simply don't all want to become energy experts in order to make their own choice to opt in.

Six of the 8 CCA states are currently "restructured" states with fully competitive retail electricity markets, where vertically-integrated utilities have been "unbundled" into separate electricity generation and electricity delivery companies. The utility continues to own and operate its distribution system (the "wires company") as a PUC-regulated monopoly. However, its generation assets were either sold off or divested to an independent generation company that must compete with other suppliers of retail electricity (independent power producers or power marketers) **[25]**. Therefore, IOUs in restructured (competitive) states are no longer vertically integrated.

California is somewhat different from the other CCA states in that it is no longer a fully restructured state, having "partially re-regulated" after the ENRON-inspired California energy crisis of the early 2000s. California's three IOUs now have default monopoly control over the electricity supply within their territory, similar to Colorado's vertically-integrated monopoly IOUs. To be clear, California was a fully restructured state at the time that CCA legislation was passed, like the other CCA states, but it is

now implementing CCA in an environment that is somewhat similar to Colorado in that its IOUs could once again be described as vertically integrated.[**]

Unlike Colorado, communities in California can choose to exit their IOU and form or join a CCA to provide their electricity supply. However, in other fully restructured CCA states like Illinois, communities have much more freedom because they can choose from many competing electricity suppliers operating in the state, or elect to remain with "bundled service" from the IOU.

There is another important difference between Colorado and the CCA states: Colorado is not part of a Regional Transmission Organization (RTO), which is an independent, non-profit operator of a state-size or larger integrated transmission grid. It is straightforward in areas within an RTO to send power from any producer to any city across the transmission systems of many owners, because part of being in an RTO is having a "common transmission tariff" where everyone has the same access and pays the same rates for "wheeling" power across the transmission system **[26]**. In Colorado, and in most of the West except California, each utility controls its own transmission system and sets its own rules and rates, so wheeling power across multiple transmission systems is complicated by the need for individual bilateral agreements with each involved utility (called "pancaked rates"). There have been no cases of a state adopting CCA legislation without also belonging to an RTO to facilitate the movement of wholesale power. However, there is increasing momentum for a west-wide regional grid that would solve this difficulty, with the additional benefits of lower transmission costs and the ability to integrate more renewable energy cost-effectively. A western RTO may or may not involve expansion of California's RTO (called the California Independent System Operator, or CAISO) **[27,28,29]**.

To implement CCA in Colorado, the legislature would need to enact CCA legislation, and the PUC would need to adopt corresponding rules and regulations. This has previously occurred only in restructured states with competitive retail markets. An integrated transmission grid and wholesale electricity market would also be desirable, if not necessary.

The next two sections of this paper look more closely at how CCA works in two example states, California and Illinois.

[**] *Experts disagree on when it is proper to use the term "vertically integrated." In this paper, we use the term to indicate that an IOU controls both the supply and delivery of electricity within its territory, regardless of whether the IOU owns the electricity generation assets or whether it acquires the electricity through power purchase agreements or market purchases.*

3.1.1 CCA as implemented in California

Of the current CCA states, California provides the closest analogue to Colorado because it is currently a regulated monopoly state with three vertically-integrated IOUs. To be clear, there are many differences between the Colorado and California regulatory systems, but not quite as many differences as between Colorado and Illinois.

In California, CCAs are approved by the local governing body of a city, county, or special district, unlike other CCA states that require a public vote to form or join a CCA **[30]**. Everyone in the jurisdiction is automatically enrolled in the CCA, but there is an opt-out provision where individuals can choose to purchase their electricity from the IOU that delivers the electricity to everyone in its territory, both CCA customers and those that have opted out (known as "bundled" customers). Opt-out rates for California CCAs are around 3% (so, 97% participation).

CCAs, where they exist, are the only alternative to buying electricity from the incumbent IOU. CCAs are not allowed in cities with their own municipal electric utility. Some CCAs procure power for a single city, while others that represent more than one jurisdiction are run by a "Joint Power Authority" (JPA), where each jurisdiction has one seat on the JPA's Board of Directors, usually an elected official appointed by the jurisdiction's governing body. After a CCA has demonstrated successful operation, it is allowed to expand and add customers elsewhere in the state, as several CCAs have done.

New CCAs typically sign 5-year contracts with power providers, whereas more established CCAs, having demonstrated viability and qualified for credit, often sign 15-25 year Power Purchase Agreements (PPAs) for renewable energy. California CCAs typically try to offer at least one rate plan that is slightly cheaper and with a higher renewable energy content than the IOU, as well as one or more high-renewable or 100% renewable plan that may cost slightly more than the IOU. The relationship between rates and renewable energy content will likely change over time as the cost of renewable energy continues to decrease. Some CCAs also promote local renewable energy development as a core goal, and they often offer higher net metering credit for exported solar energy than is offered by the IOU. Some CCAs are also more adept at developing local energy efficiency or demand response programs than the IOU. The UCLA Luskin Center for Innovation summarizes the impact of CCAs on the California electricity grid **[31]**.

The history of CCA in California began with its authorization in 2002, but it has been a long road to success, in part because California reverted to being a vertically-integrated state, and its IOUs have waged a fierce and well-funded campaign to defeat the rise of CCAs, first by direct prevention and now by making them more expensive to operate and therefore less competitive through increased "exit fees" when customers leave the IOU (described below). As one example, in 2010 Pacific Gas and Electric (PG&E) spent $44 million to fund an initiative for a constitutional amendment that would have required a two-thirds supermajority vote by local governments before they could

fund the establishment of a CCA **[32]**. The initiative failed, and the legislature subsequently passed a law in 2011 that prohibits utilities from direct marketing against CCAs.

The rapid increase in CCAs after 2014 poses a threat to the monopoly IOU model, as more and more customer load departs for CCAs **[33,34]**. A study by the California PUC predicts that as much as 85% of customer load could be served by CCAs and other non-IOU providers by 2025 **[35,36]**. California could conceivably become almost a de facto restructured state again, via the roundabout path of increasingly unbundled electricity generation, a notably different path than the 14 states that became fully restructured by legislative design in the mid 1990s to early 2000s (as did California too, prior to partially re-regulating after the infamous California energy crisis).

An on-going issue of significance for the future of CCAs in California (but not in the other CCA states) concerns the assessment of "exit fees" that CCAs must pay to IOUs to account for the costs of legacy IOU generation contracts that were signed before the customer load departed to the CCA. This charge is intended to prevent the shifting of those contract costs onto the remaining IOU customers; it is also called the Power Charge Indifference Adjustment (PCIA). Therefore, a CCA can only offer lower prices than the IOU if it can procure or produce wholesale power not only cheaper than the IOU, but also cheap enough to cover the PCIA charge. This appears to be possible at the moment, but the future depends on ongoing proceedings about the appropriate level of the PCIA charge **[37,38]**. Over time, IOU legacy assets will be paid off, and the PCIA will presumably decrease and ultimately disappear.

Marin Clean Energy (MCE) – California's first CCA

As California's most mature CCA, launched in 2010, MCE provides a good example of how a CCA works and what it can offer customers **[39]**. MCE serves Marin County, Napa County, and over a dozen cities. Any customer can easily opt out online and receive "bundled service" from PG&E **[39-optout]**.

MCE offers 3 rate plans with a different mix of renewable energy (RE): "light green" (currently 61% RE); "deep green" (100% RE); and "local sol" (100% locally produced solar power) **[39-energy mix]**. For comparison, PG&E's standard service is currently 33% RE.

MCE conducts integrated resource planning, and procures its energy annually in an open competitive process **[39-procurement]**.

Detailed rate schedules are available online **[39-rates]**. Rates are difficult to compare because it depends on how much energy is used, and the ratio of energy charges versus fixed fees. There are two parts to rates: 1) the electricity delivery

charge, which is the same for both CCA and PG&E customers; and 2) the energy charge which depends on how many kilowatt-hours (kWh) are consumed and the rate plan chosen, which each have a different kWh rate. Also, CCA customers pay the PCIA charge ("exit fee") described earlier. This is summarized below for a typical residential customer that uses 451 kWh per month (seasonal average, valid August 2018).

Table 1. Monthly Bill Comparison for a Typical Residential Customer

Provider **Product** (RE %)	**MCE** **Light Green** (61% RE)	**PG&E** (33% RE)	**MCE** **Deep Green** (100% RE)	**MCE** **Local Sol** (100% local solar)
Total bill	**$101.43**	**$104.04**	**105.94**	**134.80**
Delivery charge	$55.42	$55.42	$55.42	$55.42
Energy charge	$30.67	$48.62	$35.18	$64.04
PG&E fees*	$15.34	-	$15.34	$15.34

* "PG&E fees" includes the PCIA charge, and the franchise fee charged by cities and counties to all customers and collected by PG&E.

Light Green is 2.5% cheaper than PG&E for a substantially higher RE content; Deep Green is 1.8% more expensive than PG&E for 100% RE; and Local Sol comes at a premium of 30% compared to PG&E. It is important to note that these rates will change over time for at least three reasons: 1) the cost of renewable energy will continue to decrease over time; 2) time-of-use rates are an option that will become the default in California in 2019 **[40,41]**; and 3) the outcome of the PCIA issue and how it will evolve over time is unknown.

MCE has collected a set of resources for answering questions about CCAs, as well as information and documents related to joining an existing CCA or forming a new CCA **[39-resources]**.

3.1.2 CCA in a fully competitive state – Illinois

Unlike California or Colorado which have vertically-integrated IOUs, the IOUs in Illinois and other CCA states are fully restructured, meaning that there is a functional separation between electricity supply and electricity delivery **[42]**. Restructured states have a competitive retail electricity market, where individuals and businesses can choose their electricity supplier. The incumbent IOUs (ComEd and Ameren in Illinois) are "wires companies" that own, operate and maintain the distribution system, and manage billing and customer service, but don't own any generation. Their role is to

facilitate the delivery of electricity from any retail electricity supplier (an independent power producer or power marketer) to end-use customers.

Restructuring legislation was passed in Illinois in 1997, with customer choice phasing in for commercial customers in 1999 and for individuals in 2002. Subsequent legislation established a retail electricity market in 2006, and led to community choice aggregation in 2010, which is called Municipal Electricity Aggregation (MEA) in Illinois **[43].** As in other states, customer choice is only available to IOU customers; electric co-ops and municipal utilities are exempt from customer choice and from municipal aggregation.

IOUs in restructured states have no stake in the electricity supply, so they are generally a willing partner for MEAs, not an adversary as in California where IOUs are in competition with CCAs. Furthermore, alternative suppliers also like the MEAs, because it is far easier and cheaper to compete for supply contracts with a large aggregated load than it is to pursue individual customers "door to door."

An Illinois community that wants to establish a MEA has two options: "opt-out" (most common) and "opt-in" **[42,43]**. The opt-out approach requires that voters pass a referendum, after which the entire community is enrolled with the chosen alternative supplier, but individual customers can still opt out and choose their own supplier if they wish. It is also possible in Illinois, but not common, to establish a MEA by ordinance, but it will be opt-in where each individual must choose to join the MEA, leading to far lower adoption rates.

Recall that in California, forming or joining a CCA with an opt-out provision can be approved by ordinance by the City Council or other governing body. Also in California, the only option for those that opt out of the CCA is the incumbent IOU's "bundled service." In Illinois, an individual opting out can choose either the incumbent IOU or any other competitive supplier that serves their area. Since IOUs in restructured states don't own generation, they purchase power on the open market and deliver it to their bundled customers as a pass-through cost, so IOUs don't have a profit motive to actively pursue opt-out customers. In many restructured states, the IOU's price is called the "price to compare" or the "price to beat," and is a standard against which alternative supplier prices can be compared.

The website "Plug In Illinois" **[44]** has Information about the state-certified electricity suppliers, rate comparisons, and the status of all MEAs including their supplier, rate, and contract end date **[44-community list]**. Typical contract lengths are 1-3 years.

The listed status of some MEA communities indicates that their program has expired and they do not have a selected supplier, which means that they get their electricity as bundled service from ComEd or Ameren. The MEA market initially grew quickly because competitive suppliers could beat the price of the incumbent utility's bundled service by up to 3 cents/kWh **[43]**. By late 2013, 70% of residential and

business customers in ComEd territory received their electricity from a MEA. In 2014, 720 Illinois communities had formed MEAs, but thereafter the prices offered by the incumbent utilities came down (suggesting that competition works), and about 100 MEAs returned to bundled service over the next year. Beginning in 2017, MEAs were again able to offer a small cost advantage. As of October 2017, of the 745 communities eligible to choose a supplier, 571 had done so, 24 were listed as "referendum passed," and 150 had expired contracts and had reverted to their IOU. As the cost of renewable energy continues to decline, and as communities increasingly consider energy sources and not just prices, it is advantageous for communities that have passed a referendum to periodically look at the market, evaluate their priorities, and change their mind as opportunities arise.

A utility bill in Illinois contains 3 separate charges: electricity supply; transmission service; and distribution service. Only the electricity supply is competitive. The delivery charges are paid to the IOU by all customers, those with bundled service from the IOU as well as those with an alternative supplier.

It is instructive to compare how "stranded costs" are managed in a fully restructured state like Illinois versus in California. Stranded costs are the difference in the value of an IOU's assets and contracts before and after the electric load of IOU customers departs for a competitive supplier **[45]**. In California, the IOUs fight fiercely against CCAs. They are in contention with each other, and with regulators over the proper charge for stranded costs that is needed to avoid shifting those costs onto the remaining IOU customers. This is the PCIA charge ("exit fee") that California CCA customers must pay to account for their share of costs that were previously approved by the PUC to serve those now-departing customers.

In contrast, Illinois IOUs are "wires-only" companies, as the vertically-integrated company was "unbundled" into separate generation and delivery companies during restructuring. However, restructuring leads to an analogous situation where there are stranded assets and other financial ramifications as a result of splitting the company and opening electricity supply to competition. This situation was dealt with as part of the restructuring process, so there is no longer a question of "cost shifts" when communities switch to a competitive supplier. That is, stranded assets in Illinois were dealt with more cleanly and at the state level during restructuring; they were paid for by all customers with a non-bypassable charge over a limited time following restructuring, as opposed to California's on-going contentious process between each IOU and its customers who depart for a CCA. In some restructured states, stranded cost recovery was unnecessary because the sold-off generation assets had sufficient value to cover their remaining undepreciated costs.

Illinois is only one example of how Community Choice works in a restructured state. Examining other restructured states would provide additional "lessons learned" and "best practices" to consider. The following are additional reasons, beyond meeting the needs of communities with ambitious energy goals, to study restructuring and the adoption of retail competition and consumer choice in Colorado **[46]**:

- Competition lowers costs for consumers **[47,48,49,50]**.
- Competition and consumer choice would accelerate the clean energy transition as the cost of renewable energy and energy storage continues to decline **[20,51]**.
- Corporations want to contract directly for low-cost renewables **[11]**. Many have 100% renewable energy goals **[5]**. States without corporate choice may have difficulty attracting and keeping energy intensive businesses **[12]**.
- Electricity generation is no longer a "natural monopoly." Monopoly status cannot be justified for a commodity (electricity) where competition has proven successful.
- Competition shifts the risk of generation investment from consumers to the private sector, where it belongs.
- The cost-of-service utility model, where utilities earn returns only on invested capital, tends to inflate costs by encouraging overbuilding, stifling innovation, and disincentivizing energy efficiency.
- Competition would likely accelerate innovation if third parties could propose alternatives to new transmission and distribution infrastructure and centralized generation ("non-wires alternatives" and "distributed energy resources").

Restructuring in Colorado would most likely be opposed by IOUs that fear the loss of their monopoly position, even though history has shown that utilities are made whole for stranded costs that result from restructuring. However, in at least the case of Massachusetts, the CEO of the largest IOU in the state evolved from a position of strong opposition to one of leadership in the restructuring effort once it became clear that stranded costs would be recovered and that restructuring was actually a good way to reduce risk for the company during a time of change **[52]**. A time of change is at hand once again.

3.2 Community Energy Act (HB18-1428), with improvements

If Colorado IOUs have a preferred solution for addressing community energy goals, it is probably HB18-1428, a bill put forward in the 2018 legislative session called the "Colorado Community Energy and Innovation Collaboration Act" **[53]**. The bill did not pass, but some form of it may reappear in a future session, and therefore it merits examination as a possible way for communities to pursue their energy goals within the context of the current vertically-integrated monopoly system and cost-of-service utility model.

The bill would have established a process where an IOU can enter into a collaborative agreement with a city and/or county that is within the IOU's service territory. An acceptable agreement was defined by the following characteristics:

- The agreement must be approved by the PUC.

- Reliable service must be maintained.
- Additional costs to the utility must be paid by the community.
- The agreement cannot shift costs onto other utility customers.
- The agreement must be mutually acceptable to the utility and the community.

The bill was quite general in nature; no examples of acceptable agreements were given. While the bill sounded promising, there were shortcomings in both the language of the bill and the manner in which it was brought forward in the legislature. It clearly served the interests of utilities more than the interests of communities. However, an examination of its shortcomings is instructive for informing and improving any similar bill in the future.

Shortcomings of HB18-1428 and recommendations for improvement:

- Insufficient legislative process. Despite the bill's sweeping consequences for Colorado communities, there was a very limited public vetting process. The bill was introduced late in the legislative session, and its potential unintended consequences were not well understood by the legislators who had to vote on it.
- Insufficient stakeholder input. Those most affected by the legislation should have had substantial input in its drafting, including at a minimum: cities that have energy goals; the business community (including independent power producers); large commercial and industrial energy users; and environmental and consumer advocates. A broad and transparent stakeholder process, with input from diverse perspectives, would ensure that renewable energy goals could actually be accomplished cost-effectively by the legislation.
- No PUC input. PUC Commissioners and Staff would be called upon to implement the legislation and merge it with existing regulations, and therefore the bill might have benefitted from their input.
- Extreme power imbalance. The agreements authorized by the bill were to be crafted in private by two parties: the city in question (perhaps the city manager and staff, the mayor, and/or the city attorney), and the utility, backed by a large number of lawyers with enormous technical and legal expertise about energy. This was a recipe for agreements that favor the utility over the city, and agreements that may have non-obvious consequences that are beyond what a city attorney might recognize or have the resources to research.
- Utility as gatekeeper. By requiring utility consent before any proposed agreement could advance to the PUC, the utility becomes the gatekeeper of all possible agreements. No proposal that was not primarily favorable to the utility would ever move forward. An independent evaluator or other third party would bring fairness to the process by preventing utilities from unilaterally blocking viable agreements proposed by cities. An independent evaluator would also reduce the power imbalance.

- Entrenchment of the monopoly. At a time when consumers would benefit from greater competition and consumer choice in the electricity sector, the bill as written would have further entrenched monopoly control over electricity in Colorado.
- A narrower bill might be more effective. The generality of the bill would theoretically allow communities to address any energy goal. However, beginning with a narrower bill that focuses on a single common energy goal – such as obtaining 100% renewable electricity, or implementing on-bill financing of city-sponsored energy efficiency and distributed generation projects – might improve the bill's chances of success, demonstrate the effectiveness of the approach, and minimize the potential for unintended consequences from a broader, more general, more complex bill. A narrower bill would give confidence that utilities are willing to engage in good faith, and would put less of a burden on the PUC by eliminating the need for detailed evaluation of many individual bilateral agreements that accomplish essentially the same thing.
- Allow cities with similar goals to coordinate. Groups of cities and counties should be able to collaborate on the development of proposals, and then approach the utility as a group to discuss the utility perspective. If there are disagreements, an independent evaluator could determine if the proposal meets the requirements of the bill. For example, several cities with renewable energy goals may wish to coordinate on a solicitation for power purchase agreements or community solar facilities in order to get lower bids. Similarly, several cities may want to collaborate on designing an on-bill financing program that allows city-sponsored customer energy efficiency or distributed generation projects to be paid for over time on a customer's energy bill.
- Examples would guarantee a shared understanding. The bill did not make it clear that utilities would approve any proposals at all that cities might put forward or support. Sincerity and clarity could be demonstrated by outlining high-level language in the bill that illustrates one or two programs that cities might be interested in.
- Costs are considered, but not benefits. The bill made clear that any additional costs of the agreement to the utility must be borne by the community, which is fair. But no mention was made of rebates or rate reductions for the community if the agreement actually reduces costs for the utility. Any future bill should be clear that communities will receive the benefits if the agreement results in lower costs for the utility or its other customers. This will become increasingly relevant as renewable energy gets cheaper.
- Lack of uniformity sets up a legal conundrum. A fundamental requirement of regulated monopolies is that all customers in a customer class must be treated equally. If community A strikes deal #1, and community B strikes deal #2 to achieve the same goal (say, obtaining 100% renewable energy), and deal #1 is much better than deal #2 for the community, then, although nothing in the bill was violated, a case could be made that the requirement for fundamental fairness to all customers was violated. This argues for a single approach, or a template, to address any given energy goal.
- Balkanized solutions hinder system-wide progress. Good ideas should be available to all. The bill opened the door to charging individual communities for things that might be more cost-effective for consumers if they were implemented at the system level. Working with cities one at a time is inefficient, for both the cities and for the PUC,

which argues for making optimized solutions for the most common city energy goals available as pre-approved templates.

HB18-1428 required a competitive bidding process for any new resources that are acquired as part of an agreement, and resources acquired under multiple agreements could be aggregated. These are sensible aspects of any future bill. However, the bill was unclear about whether utilities would be allowed to own and earn a return on any of the new resources, which would add to the cost for the community.

3.3 Municipalization

Municipalization refers to forming a new municipal (city-owned) electric utility by acquiring and operating the distribution system assets (poles, wires, and substations) of the incumbent IOU. The American Public Power Association (APPA) **[54]** provides a guide for cities considering municipalization **[54-guide]**. Municipalization laws vary by state, but in Colorado, a city may purchase the assets of the incumbent IOU at an agreed price, or it may condemn the assets and pay fair market value, most likely as determined by a court **[54-state laws]**.

The key difference between municipalization and a California-style CCA or Illinois-style MEA is that a municipal utility owns the distribution system infrastructure and has the responsibility of reliably operating and maintaining it (or contracting for its operation), in addition to the core responsibility of a CCA or MEA which is to purchase or produce the electricity.

The motivation to municipalize generally arises from a difference in priorities and goals between a city and the incumbent IOU, as is the case for the two Colorado examples discussed in this section, Boulder and Pueblo. IOUs must, by law, seek to maximize profits to fulfill their fiduciary responsibility to their shareholders, whereas municipal utilities are free to prioritize serving their customers' and community's needs, goals, and best interests.

Reasons that cities might consider municipalization: [55, 54-guide]

- Obtain more freedom to pursue policy goals that are not shared by the IOU, including sustainability goals such as 100% renewable energy.
- Reduce electricity prices **[56,57]**. Municipal utilities typically have lower rates than IOUs because they are: non-profits that don't pay dividends to shareholders; exempt from federal taxes; usually have lower borrowing costs (municipal bonds); and have no economic bias toward maximizing electricity sales or investing in the capital-intensive technologies that are incentivized by the cost-of-service regulated utility model.
- Have more flexibility to pursue local energy programs such as distributed generation, energy efficiency, and related services such as broadband. IOUs may resist or downplay programs that reduce consumption and thereby reduce profits, illustrating a fundamental misalignment of IOU and consumer interests.

- Exercise greater autonomy, self-reliance, and consumer choice.
- Exercise local control over investment decisions and the associated economic development. A city can better optimize the power grid to meet its goals than can a remote utility with different goals.
- Offer relatively easy access to the governing body and utility decision makers by its customers.
- Create more local jobs, including the economic multiplier effect of keeping more energy dollars local.
- Address dissatisfaction with an IOU that is seen as not well run, not serving the city well, or is not accessible for community input and concerns.
- Counter perceived monopoly power and corruption.

Although there are 29 municipal utilities in Colorado, most have existed for decades. Forming a new one is rare. There were only 13 successful conversions from an IOU to a municipal utility across the entire country between 2006 and 2016, and most were in towns with a population of less than 10,000 **[55]**. Although cities have much experience running water and sewer utilities, most do not want to also run their own electric utility, which requires much technical expertise as well as compliance with many levels of regulation to ensure reliability of the larger electricity grid. Expertise can either be contracted out or developed in-house; but in either case, the transition costs to get a new municipal electric utility up and running can be steep. Depending on the age of the system, the cost to purchase the incumbent utility's infrastructure can be a barrier, and the incumbent will likely use their considerable financial, legal and political resources to fight municipalization in a long and costly court battle.

Boulder, Colorado:

The City of Boulder has had a greenhouse gas emissions reduction target since 2002, and began exploring municipalization in 2010 as a faster, better, cheaper way to reach its energy and climate goals – 100% renewable electricity by 2030 and an 80% reduction in carbon emissions by 2050 – than was possible with the incumbent IOU, Xcel Energy **[58]**.

After preliminary research and modeling, the first major step toward municipalization was a ballot question that allowed Xcel's 20-year franchise agreement with the city to expire. The 3% franchise fee on ratepayer energy bills – an important revenue stream for the city – was replaced with an equivalent "utility occupation tax," thereby preserving the revenue stream while freeing the city from the main reason to renew its 20-year agreement with Xcel. Franchise agreements allow an IOU to use city property for its poles and wires; however, it is state law that an IOU must still provide the city with electricity even without a franchise agreement. Since 2011, the city has repeatedly sought to partner with Xcel or construct "side agreements" that would allow the city to reach its energy goals under the monopoly IOU system, but those efforts have been unsuccessful.

Numerous consultant reports, analyses and modeling by local energy and technical experts support the conclusion that a municipal electric utility in Boulder is both economically viable and would provide a path for rapid decarbonization of its electricity supply.

The process of municipalization continues as of late 2018. There have been hearings and decisions at the PUC to determine which Xcel assets would be transferred to the city. Six ballot questions have been passed that authorize municipalization or continue the funding to explore and pursue municipalization. There has also been a question put on the ballot by Xcel aimed at derailing the municipalization effort, which was soundly defeated. There have been suits and counter-suits in Boulder County District Court over the formation of a municipal utility and over condemnation of Xcel's assets, in advance of an expected court battle over the value of those assets.

The lesson for cities that consider municipalization is that it is likely to be a contentious and long process, involving much litigation and expense, and while there is evidence from other cases that municipalization can bring many benefits to a community, it requires commitment and resources to see it through. In Boulder, a final go/no-go vote on municipalization is expected in 2020.

Boulder represents about 5% of Xcel's electrical load in Colorado, and Boulder ratepayers provide Xcel with approximately $35 million annually in profit. Therefore, the motivation to succeed is strong on both sides. Not only are shareholder returns at stake for Xcel, but a precedent for customer defection from the utility is at risk. For Boulder, substantial dollars are at stake that could be retained by the city for rate reductions and/or investments in its own electricity system that supports the local economy and the pursuit of city energy goals.

Pueblo, Colorado:

The City of Pueblo is exploring municipalization as an alternative to its incumbent IOU, Black Hills Energy. There is an opportunity in 2020 for Pueblo to end its 20-year franchise agreement with Black Hills 10 years early, called an "off ramp." Exiting the franchise agreement would allow Pueblo to explore other options, including municipalization, similar to the early step taken by Boulder. Exiting the franchise agreement would require a vote of the people.

Opposition to Black Hills has been led by a coalition of community groups and representatives of local government known as "Pueblo's Energy Future" **[59]**, as well as by the business community. The city council established a committee in 2017 to study the city's options for taking the 2020 off ramp **[60],** and in August 2018, the city council committed funding for a feasibility study to evaluate the legal, technical and financial requirements for ending the city's association with Black Hills and forming a municipal electric utility **[61]**. In late 2018, the city's consultants will present Phase I of the municipalization feasibility study, which will estimate the costs of the transition. Phase II

of the study, examining alternatives to Black Hills, will likely be completed by the summer of 2019.

The motivations for many in Pueblo to consider alternatives to Black Hills arise from great dissatisfaction with their utility **[62]**, for four main reasons:

- Numerous rate increases that occurred after Black Hills took over operations in 2008, resulting from the company's decision to build its own natural gas generating plants to replace a previous power purchase agreement with Xcel Energy. Electricity rates in Pueblo are much higher than Denver's rates or the state average rate **[63]**.
- Unusually high demand charges for commercial customers.
- Harsh treatment of low-income customers and large volumes of shut-offs.
- No perceived path to achieving Pueblo's goal of 100% renewable electricity by 2035, a goal which has also been joined by Pueblo County **[64]**.

The APPA guide to municipalization **[54-guide]** lists the general steps involved in forming a municipal utility, and discusses likely responses by the incumbent utility. The guide also debunks myths and misinformation about public power and about forming a new municipal utility, and gives examples of successful public power campaigns.

A notable insight from the APPA guide is that the act of beginning to study municipalization is sometimes enough to bring IOUs to the bargaining table to address community energy goals. This seems to be occurring in Pueblo, with Black Hills modifying its disconnection policies and reconnection fees, and lowering monthly rates and commercial demand charges **[65]**. The PUC has also taken note of the community dissatisfaction and has mandated numerous changes in the company's rate structure, for commercial customers and net-metered solar customers in particular **[62]**.

3.4 Utility-provided 100%** renewable electricity for everyone

Regulated monopolies are required to provide everyone in their service territory with the same level of service and opportunities – special deals that are not available to everyone are not allowed. This poses a challenge for IOUs to provide 100% renewable energy to individual communities. Furthermore, any program that is available to everyone must also ensure that there are no "cost shifts" between customers or customer classes.

These complexities could be eliminated if a utility provided 100% renewable energy to everyone in its territory. IOUs, as well as wholesale electricity suppliers, could

** *In this paper (and most other contexts), "100%" renewable energy should not be taken as strictly literal, but rather as "nearly 100%," especially in the short term when some amount of fossil fuels would be needed for balancing variable renewable energy.*

choose to accelerate the on-going transition to renewable energy, and thereby meet the demands of cities and large companies with ambitious energy goals as a byproduct of a larger forward-looking vision. Utilities could choose to lead the way to the electricity system of the future and find ways to do so profitably, as opposed to the status quo of resisting and incrementally yielding to customer pressure and legislation.

This section examines the technical and economic feasibility of a utility accelerating its transition to renewable energy system-wide. A specific path forward is not proposed, as that must come from the utilities working in conjunction with energy thought leaders, research organizations, and stakeholders that are on the cutting-edge of this topic.

In order to examine the feasibility of a utility reaching a very high level of renewable energy cost-effectively, it is instructive to first examine what is already possible at the scale of an individual city, and then examine what appears to be possible theoretically at much larger scales, such as the scale of an entire state, country, or the world, based on academic studies of a high-renewables grid. Finally, the feasibility of providing 100% renewable energy at the scale of a utility's territory can be considered as being intermediate between what is definitely possible and what appears to be theoretically possible.

Cities that have 100% renewable energy today:

A number of individual cities already obtain 100% renewable electricity today. Examples include: Burlington, Vermont; Aspen, Colorado; and Georgetown, Texas. These cities were able to achieve their energy goals in part by taking advantage of locally-produced energy that differs by region.

- Burlington, Vermont. Burlington, population 42,000, became the first city in the country to obtain 100% renewable electricity in 2015. The city receives 50% of its energy from hydroelectric generators (both local and in Maine); 20% from local wind and solar; and 30% from a biomass generating plant that consumes fallen trees from all over Vermont. The city also reduced its energy consumption through energy efficiency, at a savings to the city of about $1 million per year **[66,67]**.

- Aspen, Colorado. Aspen, population 6600, reached its goal of 100% renewable electricity in 2015. The city had met 76% of its goal by 2014 using local hydropower, wind, solar, and landfill gas **[68]**. After consulting with the National Renewable Energy Laboratory (NREL) to study its options for the remaining 24%, the city contracted with a wholesale supplier to receive power from 4 wind farms in Nebraska and South Dakota **[69]**. Energy efficiency also played an important role by reducing the city's overall electricity demand. The city's electricity rates remain among the lowest in the state.

- Georgetown, Texas. Georgetown, population 55,000, receives all of its electricity from 25-year power purchase agreements with nearby wind and solar farms, thereby

locking in prices and eliminating the risk associated with fuel cost volatility **[70,71,72]**. The city primarily switched to renewable energy for lower costs, with secondary motivations to reduce pollution and water use. A battery energy storage facility will help smooth the intermittency of renewable energy **[73]**. Excess electricity production beyond that needed to power the city is sold into the Texas wholesale market **[74]**.

Not coincidentally, all three of these cities run their own municipal electric utility and therefore have much more freedom to make their own energy decisions than cities served by an IOU or most co-ops.

High renewable energy penetration at very large scales:

Several academic studies have modeled a high-renewables future on scales much larger than the utility scale. Some of these studies go well beyond meeting current electricity demand to also consider the scenario where all transportation and heating has been electrified, and then meeting this much higher electricity demand with renewable energy. Achieving 100% renewable electricity at the utility scale would be far easier than at these larger scales.

- U.S. scale. Jacobson et al. developed a grid integration model and showed several ways that the U.S. electricity grid could be powered by 100% renewable energy and energy storage, reliably and at a lower cost than using fossil fuels **[75]**. They also developed roadmaps for each state to reach this goal **[76]**. These solutions include electrification of the transportation and heating sectors. The roadmaps indicate that 80-85% renewable energy nationwide can be achieved by 2030 *for all energy uses*, and 100% by 2050.

- Global scale. Expanding on the above study, Jacobson et al. modeled a variety of reliable, low-cost solutions to meet all energy demand in 139 countries from renewable energy and energy storage **[77]**.

- Flexibility is important. Lund et al. reviewed approaches, technologies, and strategies that increase the flexibility of the electricity system to enable high levels of variable renewable energy. The approaches include both supply-side and demand-side measures; aggregation of those measures; grid regionalization (discussed below); and many forms of energy storage, among others **[78]**.

- Early conservative scenarios. NREL conducted a highly-collaborative, detailed technical study of hourly load balancing in the U.S. with different levels of renewable energy ranging from 30% to 90%, with a focus on 80% **[79]**. The study found that renewable energy technologies that were commercially available in 2010, combined with more flexible grid design and operation, could easily supply 80% of U.S. electricity demand. It is important to note that system balancing in this study relied on flexible fossil fuel generation, as the study preceded the rise of lower-cost energy storage that can perform that function today, and it preceded the rapid price decline of solar energy,

so the study is very conservative compared to what could actually be accomplished today.

- Western interconnection. A followup to the above NREL study did cost modeling for the operation of the Western grid at 5-minute resolution and determined that the western region could be operated reliably with 82-88% renewable energy, with only minimal use of battery energy storage **[80]**.

- Interconnection of interconnections. An ongoing modeling study led by NREL is investigating the benefits of greatly expanding the capacity of existing DC interties between the Eastern and Western grids, of building additional DC transmission capacity, and of creating a national-scale high voltage DC transmission network **[81,82]**. Continent-scale integration of the electricity grid using energy efficient high voltage DC transmission could greatly expand the ability to transport renewable energy from areas where the resource is abundant to load centers where there is a relative scarcity of renewable resources. The enhanced flexibility enabled by substantial new transmission capacity over larger regions would support higher proportions of renewable energy in the generation mix while maintaining or enhancing grid reliability and reducing overall costs.

The main conclusion from these studies is that it is realistically feasible to run the whole state, country, or the world on renewable energy, so it is realistic to consider the simpler situation of powering individual utility territories with renewable energy using existing technology.

100% renewable electricity at the utility scale:

The above sections suggest that it may be technically and economically feasible to shift a utility-scale territory to 100% renewable energy. The following factors add support to this conclusion:

- RMI renewable portfolio study. This Rocky Mountain Institute (RMI) report advises utilities and regulators to consider generation portfolios that contain more renewable energy and distributed energy resources (such as battery energy storage, demand response, and energy efficiency), and contain less natural gas generation, in order to reduce the risks of stranded assets, fuel-cost volatility, and a possible future carbon price **[83]**. The report analyzed four geographically diverse projects and found that "*All four cases show that an optimized clean energy portfolio is more cost-effective and lower in risk than the proposed gas plant*" **[7]**.

- RMI Tri-State study. This RMI report found that Tri-State Generation and Transmission Association, the wholesale electricity supplier for most of Colorado's electric co-ops, could save their members $600 million through 2030 by procuring low-cost renewable energy to replace the high operating costs of their aging coal generation fleet, while also maintaining system reliability and reducing the risk of rate increases **[84]**. This study is consistent with other findings that many coal plants operated by western IOUs

are uneconomical, and ratepayers would save money if these plants were retired early and replaced with renewable energy plus energy storage **[8,9]**.

- Low-cost Xcel bids. Xcel Energy's Colorado Energy Plan **[85]** will close two coal-fired generating units a decade early and replace their energy and capacity with a combination of wind, solar, and battery energy storage, at an estimated savings to ratepayers of over $200 million **[10, 86]**. The savings result from unprecedented low prices for renewable energy, coupled with unexpected low prices for energy storage which smoothes the intermittency of renewable energy and allows "time shifting" of solar energy from when it's produced to later in the day when it's needed most **[51]**. The Xcel bids are consistent with observed cost trends, and with the expectation that the cost of renewable energy will continue to decline **[19]**, which will make it increasingly economically attractive to replace fossil fuel generation with renewable energy plus energy storage.

- Grid regionalization (and wholesale markets). In most of the eastern U.S., plus in California, the electrical transmission grid is operated on a state or regional scale that encompasses many utility territories, and the region employs a competitive wholesale bidding market that dispatches the most cost-effective electricity first **[87]**. This allows electricity to be traded between regions of oversupply and regions of undersupply, which facilitates greater penetration of variable renewable energy, uses the grid more efficiently, and thereby lowers costs. At long last there is on-going coordination in the western grid for real-time electricity trading **[88]**, and there is serious discussion of a single west-wide integrated transmission grid with wholesale electricity markets **[89,90,91]**. Western grid regionalization would facilitate individual utilities increasing their fraction of renewable energy cost-effectively while maintaining reliability.

Utility-scale studies and other evidence shows that there are no significant technical or economic barriers preventing utilities from providing all of their customers with 100% renewable electricity, and to do so cost-effectively for ratepayers, largely as a result of the decreasing cost of renewable energy, energy storage, and energy efficiency. The last few years have shown that virtually everyone has underestimated the speed of cost declines and the viability of a high-renewables electricity system.

The initial utility reaction to the idea of an early and aggressive transition of its entire system to renewable energy will almost certainly be some form of "it's too hard" or "it's too expensive." However, the public and stakeholders should not accept such claims if they come before any serious investigation of the available options in a transparent forum, because energy thought leaders say that it is possible.

3.5 Green tariffs – Adapting programs for large corporations to cities

Many companies have 100% renewable energy goals **[5]**. Green tariffs are special utility programs designed for large commercial and industrial energy users in some regulated monopoly states that allow them to buy renewable electricity from a

specific project through a special utility tariff (rate) **[92]**. Green tariff programs must be approved by the state PUC.

Colorado cities with renewable energy goals could also be characterized as large energy users in a regulated monopoly state looking for cost-effective renewable energy choices, which suggests the idea of designing something like a green tariff that is available to cities or counties. Any such program, for either corporations or cities, must meet the same requirement of the PUC that no costs are shifted onto other customers or customer classes.

A green tariff designed for cities is an example of the type of agreement that could be enabled by legislation like the Community Energy Act (HB18-1428), discussed in Section 3.2. One suggestion in Section 3.2 was for a narrower bill that would provide a template for an agreement that addresses one specific energy goal like obtaining 100% renewable energy. A green tariff for cities would be just such a template.

This section will describe the basics of corporate green tariffs in order to illustrate their possible application to cities, including principles that are characteristic of "good green tariffs."

Advantages of green tariffs include [92]:

- Direct transaction with the local utility.
- Provides an option for large energy users in regulated markets to address sustainability and renewable energy goals.
- Provides predictability and reduces risk by locking in long-term rates that are not subject to fuel-price volatility or future regulations on fossil fuels such as a price on carbon.
- Potential cost savings, especially as the cost of renewable energy declines.
- Enables companies to point to a specific, often local, renewable energy project as the source of their electricity.

Disadvantages of green tariffs include:

- Only offered in a limited number of regulated monopoly states by a few utilities.
- Generally only available to large energy users, not all companies.
- May require a long-term commitment.

Corporations in states with competitive retail electricity markets can simply contract directly with renewable energy developers or power marketers, similar to cities in Illinois as discussed in Section 3.1.2.

Background on green tariffs:

Renewable Energy Credits (RECs) are the "clean energy environmental attributes" of renewable energy projects, and are treated as a separate product from the energy itself. RECs, and renewable energy, can either be sold together ("bundled"), or separately ("unbundled"). Buying only unbundled RECs from an existing project does not directly increase the amount of renewable energy in the world, and may be seen as mere "greenwashing" because the energy itself is sold to someone else who can also claim to be "green," so the renewable energy is actually "double counted." Companies (and cities) can insist that utilities "retire" the RECs on their behalf, so that the utility doesn't sell unbundled RECs to another customer without adding any new renewable energy to the system **[93]**.

A utility with a green tariff offering may either own the renewable energy project itself, or it may contract with an independent power producer for a power purchase agreement (PPA) that is essentially passed on to the customer. In either case, green tariff programs offered by regulated monopoly utilities must avoid shifting program costs and risks onto non-participating customers.

The details of how a green tariff works can vary widely, and that diversity is beyond the scope of this paper. Some programs tie rates to the wholesale electricity price; others are fixed-price. Some utilities allow customers to choose a project through a competitive bidding process, which ensures that it is new renewable energy brought onto the system on the company's behalf. A more detailed overview of the types of green tariffs, with examples of each, is given by Green Biz **[94]**.

Green tariffs should not be confused with the similar-sounding "green power products." Xcel Energy's WindSource and SolarRewards programs are examples of the latter. These may be offered to any customer, including residential. They come at a cost premium, have shorter commitments, and the source of the renewable energy may be changed at any time by the utility and may not represent any specific project.

Examples of green tariffs:

- Public Service Co. of New Mexico (PNM) developed a green tariff to supply a Facebook data center with 267 MW of new wind, solar, and energy storage, locking in the company's electricity price for 20-25 years **[93]**. The contracts are based on a "green rider," or a contract template that can be customized for other individual projects. The green rider is pre-approved by regulators, which streamlines the approval process for future projects. This green tariff also illustrates the important principle of "additionality," where new renewable energy is added to the system specifically for the customer. The customer receives the RECs as well as the energy, and instructs the utility to retire the RECs so that they can't be re-sold as unbundled RECs to someone else who could then claim the environmental benefits without actually adding new renewable energy to the system.
- A number of green tariff programs are summarized by Utility Dive **[95,96]**. One noteworthy example is Puget Sound Energy's program that allows for the aggregation of smaller commercial customers as subscribers to a 130 MW wind

project. If applied to cities, aggregation of the load from multiple smaller cities would allow them to achieve the scale needed for cost-effectiveness. Facebook has been instrumental in getting multiple utilities in multiple states to offer green tariffs, by exercising its market power and requiring an energy solution from any state that wants to attract a Facebook data center.

- A description of green tariffs that are offered in regulated electricity markets, organized by state and periodically updated, is available from the World Resources Institute **[97]**.

The increasing pressure to provide low-cost renewable energy to large corporate energy users is a threat to utilities in regulated monopoly states because: "*As long as wholesale prices are lower than the energy charges large customers see on their electricity bills, they will push for better access to that savings. This is fueling interest among very large buyers in exiting utilities and buying power directly on the market"* **[98]**. States that want to keep these large employers need to ensure that they can get the low-cost renewable energy that they want **[12]**. Xcel Energy made a special deal with its largest customer, steel manufacturer EVRAZ in Pueblo, for long-term, fixed-price solar energy from an on-site array – this arrangement was pursued in part to keep the company from moving its operations out of state **[99]**. While cities cannot pick up and move if they don't get the energy deals they want, they do have considerable political power to demand a solution from decision-makers (which is the thesis of this paper).

Green Biz describes the varying success of green tariff programs offered by vertically-integrated utilities in several monopoly states **[100]**: "*Think of it as serving 30 overpriced peanut-butter-and-jelly sandwiches to 100 school kids and calling it "lunch," when many kids either can't eat, don't like or can't afford to eat them — and a lot are too far back in line and miss out altogether*." The article summarizes six essential elements of a successful utility renewable energy offering for corporations, based on a report and policy brief by Advanced Energy Economy **[101]**:

1. Avoid adversely affecting nonparticipating customers.
2. Match program pricing to the actual market prices and program costs.
3. Employ competitive project selection, which lowers costs and supports a healthy market for renewable energy.
4. Facilitate the development of new, additional renewable energy – additionality increases impact and demonstrates commitment.
5. Allow a wide variety of corporate customer types to participate – avoid narrow eligibility parameters; allow aggregation of sites; and minimize load restrictions.
6. Include varied or flexible offerings to meet the needs of different customers – one-size-fits-all is less effective given customer variability.

A seventh essential element is illustrated by Google's "next level" renewable energy goal. In 2017, Google met its goal of acquiring 100% renewable energy worldwide on a net annual basis, but that is only step 1 of their energy sustainability plan **[102,103]**. Renewable energy is intermittent, so Google met its net annual goal by over-procuring renewable energy, then exporting the excess during times of abundance (mainly daytime) to compensate for fossil fuel produced electricity from the utility during times of renewable energy scarcity (mainly nighttime). Step 2 in Google's energy sustainability plan is to power all of their facilities with 100% renewable energy on an hourly basis, 24x7, which is much more difficult. Cost-effective energy storage will help over the course of a day, but policy and market reforms are needed to enable solutions that can overcome seasonal variability.

The "corporate renewable energy buyers principles" are a list of criteria developed by a group of large energy buyers, intended to tell utilities and other suppliers what they are looking for when buying renewable energy **[11].** Most of these principles could apply to cities too.

- Greater choice in procurement options (both suppliers and products).
- More access to cost-competitive options that accurately reflect costs and benefits to the system.
- Contracts of varying length (to lock in prices and avoid fuel-price volatility).
- New projects that actually reduce emissions ("additionality" and bundled RECs).
- Projects that are near company operations, or at least on the same regional grid as operations.
- Simplified and standardized contracts, and access to third-party financing.
- Opportunities to work with local utilities to develop innovative programs and products that are cost-effective and fairly share all costs and benefits.

Corporations and cities are similar in the sense that both are large energy users, and many are seeking cost-effective renewable energy in regulated monopoly markets that offer limited options to reach energy goals. Green tariffs for corporations must adhere to the same regulatory principles that would apply to any regulatory solution for cities, including avoiding cost-shifts onto other customers. A possible downside of green tariffs, relative to solutions that would allow cities (or companies) direct access to wholesale electricity markets, is that it may be more expensive than necessary to have a utility as the "middleman."

Cities with ambitious energy goals, and large corporate energy users, are natural allies in any effort to bring about cost-effective access to 100% renewable energy. With their similar goals and similar constraints in monopoly IOU territory, they could coordinate to exercise leverage on utilities for favorable solutions, and they could apply political pressure on decision-makers to initiate a process to find the best solution.

4. WHAT ABOUT ELECTRIC CO-OPS AND MUNICIPAL UTILITIES?

Co-ops and municipal utilities are much less regulated by the PUC and the legislature than IOUs, because they are democratic, self-governing, not-for-profit entities. As a result, they have more control over how their distribution systems are run, as well as the programs and choices they offer to customers (or "members" in the co-op world). Theoretically, both co-ops and municipal utilities also have control over the supplier of their wholesale electricity, the energy sources used to produce the electricity, and the rates they charge customers to cover costs. While this is mostly true for municipal utilities, the great majority of Colorado's co-ops actually have very limited choices due to the terms of their wholesale electricity supply contracts.

This section describes several ways that co-ops and municipal utilities can pursue their energy goals independent of any state-level process to enable some form of community electricity choice. Nonetheless, co-ops and municipal utilities do have a role to play as stakeholders in any legislative or regulatory process to create a way for cities and large companies to pursue their energy goals.

Electric distribution co-operatives:

Most co-ops in Colorado (18 of 22) are members of, and receive their wholesale power from Tri-State Generation and Transmission Association. Tri-State G&T is a co-op of co-ops that collectively owns generation and transmission that serves 43 distribution co-ops in four states **[104]**. Although Tri-State is governed by its member distribution co-ops, the individual co-ops have very little flexibility and freedom to affect the energy sources used to produce their electricity, or its cost, due to Tri-State's restrictive contracts and its governance structure. There is increasing dissention and even defections by some of Tri-State's larger member co-ops that are frustrated by an inability to pursue their energy goals or reduce their electricity costs **[105,106,107]**.

Reasons for dissatisfaction with Tri-State include:

- Contract length. Tri-State contracts are 40-50 years long, tying co-ops to a single supplier and to agreements that seemed good at the time, but have become onerous as alternatives have gotten both cheaper and cleaner. The dissatisfaction began in 2005 when Tri-State proposed to build a new coal-fired generation plant in Kansas and wanted member co-ops to extend their contracts from 40 years to 50 years to pay for it (two refused) **[107]**. Tri-State finally gave up on building the new coal plant, and is slowly shedding other coal generation, but not fast enough for some members.
- Cap on local generation. Tri-State "all requirements" contracts restrict local generation of electricity within a member co-op to 5% of its peak load. As of late 2017, four co-ops had reached the cap and four more were near the cap **[105]**. This limitation is frustrating to some members because local renewable generation is cheaper, incurs no transmission charges, supports local economic development, and keeps energy dollars circulating in the local economy.

- High costs. The price of Tri-State's wholesale power, about 7.5 cents per kilowatt-hour (kWh), is much higher than the current western wholesale market price of about 3.1 cents/kWh, and higher than a Granby-based co-op's negotiated price for solar electricity of 4.5 cents/kWh **[106]**. Tri-State's high price reflects the high fuel and other operational costs of its legacy coal assets **[82]**, at a time when Xcel Energy is contracting for competitively-procured wind energy at less than 2 cents/kWh and dispatchable solar-plus-storage at 3.6 cents/kWh **[107]**.
- Governance structure and voting power. Tri-State is composed of a few large co-ops and many small co-ops, yet each co-op has one vote on the Tri-State Board. Three large Colorado co-ops (that have reached the 5% self-generation cap) have 152,000 members and 3 votes on the Board, while the 22 smallest co-ops with a total of 103,000 members have 22 votes and therefore a majority on the 43-member Board. It is difficult to change the status quo because Tri-State is effectively ruled by the smaller co-ops, which have prevented policy changes that would allow more local energy development by the co-ops that want it and that have many more members **[107]**. The Tri-State voting apportionment has been compared to the design of the U.S. Senate, but with no U.S. House to balance the decision-making with a factor that represents population. There is also an inter-state component, where 60% of the Tri-State customer base lives in Colorado, but the Colorado co-ops have only 40% of the votes on the Board **[106]**.

Tension between the Tri-State Board and some of its member co-ops arises from an inherent conflict: Tri-State has a duty to provide its members with the lowest-cost service, but the lowest-cost resources these days would be competitively-procured local generation and/or wholesale market purchases, not Tri-State's legacy fossil fuel plants.

Three ways that co-ops can increase local control over their energy sources **[105,107]**:

- Buy out the contract – Kit Carson Electric Cooperative in northern New Mexico terminated its contract with Tri-State by negotiated agreement in 2016, in pursuit of stable low-cost clean energy after experiencing 10 rate increases over the previous 13 years. The buyout involved paying Tri-State a $37 million exit fee to prevent cost-shifts onto the remaining co-ops. Kit Carson then entered into a 10-year Power Purchase Agreement with Guzman Energy. Guzman is building solar arrays across Kit Carson territory, and the co-op is buying that power at a fixed price. The new contract also gives Kit Carson the freedom to develop local renewable energy. Guzman paid the exit fee, and Kit Carson will pay Guzman back over six years, off their books, using savings from lower energy costs. Kit Carson is now insulated from the risk of rate increases associated with Tri-State's coal-heavy generation, and will save $50-70 million over the 10-year contract with Guzman. **[108,109,107]**
- Use PURPA to develop local energy – Delta-Montrose Electric Authority (DMEA), in western Colorado, challenged Tri-State's 5% cap on locally-produced electricity, with the argument that a federal law called PURPA supersedes Tri-State's "all requirements" contract. The Public Utility Regulatory Policies Act of 1978 (PURPA) **[110]** was an early step toward breaking monopoly utility control over electricity

generation. As a response to the 1973 energy crisis, PURPA required utilities to purchase electricity from any small power producer that can provide power at a price equal to or slightly above the utility's "avoided cost" for electricity. The Federal Energy Regulatory Commission (FERC) upheld the challenge, allowing DMEA to procure power from Independent Power Producers through PURPA **[111,112]**. This ruling allows all 905 electric co-ops and 830 municipal electric utilities in the nation to procure cost-competitive local power through PURPA. As of September 2018, DMEA is still waiting on another Tri-State appeal and a rehearing at FERC on the PURPA ruling. However, DMEA passed a measure in October 2018 allowing the co-op to issue stock to finance a Tri-State exit, similar to the Kit Carson approach but with a different financing mechanism **[113,114]**.

- Elect new Board members and fight harder – La Plata Electric Association (LPEA), in southwestern Colorado, had competitive races for open Board seats in a 2017 election, and the campaign largely centered on increasing renewable energy. The LPEA Board voted to approach Tri-State about increasing the cap on local renewable energy production to 10% **[115].** The resolution to raise the cap to 10% was voted down by the Tri-State Board **[106]**. Pressure to lift the 5% cap may increase as more member co-ops reach the cap, and as the cost of local renewable energy continues to decline. In January 2018, the LPEA Board voted to study alternatives to Tri-State after receiving a petition signed by 1000 people and 100 businesses calling for 100% renewable electricity and more local generation **[107]**.

Tri-State promotes the message that it has 30% renewable energy on its system, but it is mostly hydroelectric generation that has been on the system for many years, and apparently does not placate the dissatisfied co-ops. Tri-State can continue to rigidly enforce its contracts and risk more dissatisfaction and defections by more member co-ops, or it could choose to be more "cooperative" and update its business model to provide more renewable energy and allow more local energy development, which it is well positioned to facilitate for its members.

Just as IOUs could choose to address the needs of cities with 100% renewable energy goals by accelerating their own transition to renewable energy sources across their entire system and thereby eliminate the need for city-specific solutions, Tri-State could similarly transition its own energy mix more rapidly to renewable energy sources, along with facilitating more local generation, and thereby eliminate the main sources of dissatisfaction and possibly prevent future defections. A recent study makes the case that this could be done cost-effectively.

A Rocky Mountain Institute (RMI) report analyzed the economics of replacing Tri-State's coal-fired generation with renewable energy and energy storage, and found that Tri-State could provide cleaner electricity to all of its members at a lower cost than the status quo **[84,116,117].** Specifically, the RMI report showed that:

- Tri-State's coal assets are expensive to operate. It could save members $600 million through 2030 by procuring low-cost renewable energy and energy storage to replace its fleet of coal generation.
- A supply mix based on renewable generation and market purchases, versus legacy assets, would reduce the risk of rate increases by 30-60 percent while maintaining system reliability. The risk factors include: increased self-generation from members; members exiting Tri-State's system; and future greenhouse gas pricing.
- Examples are given of IOUs, co-ops, and municipal utilities that are acting now to take advantage of low renewable energy costs, currently available tax incentives, and low interest rates to finance new projects and transition away from legacy generation assets cost-effectively.
- Tri-State could facilitate a least-cost system solution that benefits all members by adopting a strategy of collective action, regionally-appropriate solutions and group buying power, as opposed to individual co-ops pursuing solutions on their own.

The RMI study is consistent with other findings that many western coal plants are uneconomical to operate, and that ratepayers would save money if these were retired early and replaced with renewable energy plus energy storage **[8,9]**. Xcel Energy received astonishingly low bids for wind, solar and energy storage to replace two Colorado coal plants **[51,86]**.

The RMI report points to an alternative to the irreversible defection of member co-ops if Tri-State acts soon enough and aggressively enough. In addition to replacing its centralized coal generation with cost-effective renewable generation and energy storage, Tri-State could also facilitate or develop local renewable energy projects for interested member co-ops. Those co-ops would benefit from the local economic development and the efficiency and cost-savings from local generation relative to long-distance transmission from centralized generators. Tri-State's current practice of opposing its members' attempts to move forward on the renewable energy transition is not sustainable in the long-term.

<u>A note about financing early plant closures</u>

Financing the early closure of uneconomic generation assets is an important consideration that can be addressed in a number of ways; however, this topic is mostly beyond the scope of this paper. As noted in Section 3.1.2, recovery of "stranded costs" when IOUs must divest their assets during restructuring, is addressed during the restructuring process. In some restructured states this involved a temporary "non-bypassable charge" on all customer bills for a limited time. However, in other states, stranded cost recovery was not needed because the sold-off generation assets had sufficient value to cover their remaining undepreciated costs. In California, IOUs recover stranded costs resulting from the loss of customers to CCAs through the PCIA charge on CCA customer bills, the amount of which is determined by the PUC.

In the case of Xcel Energy's approved early closure of the Comanche 1 and 2 coal plants in Pueblo, the remaining undepreciated capital costs of the plants will be placed into a legal structure called a "regulatory asset," which is placed into the customer ratebase. The replacement of those coal plants with renewable energy and energy storage was shown to save more than enough money over time to compensate for the accelerated depreciation **[85,86]**.

An approach that has been used in other states to reduce the costs to ratepayers of compensating utilities for their stranded assets is a financing mechanism called "securitization" **[45]**. Securitization allows the assets to be paid off by ratepayers at a substantially reduced interest rate through low-risk bonds (3-5% interest rate) rather than the existing financing at the utility's cost of capital (7-10% interest rate). This mechanism is being proposed for adoption in Colorado **[118]**.

These ways of financing the early closure of uneconomic generation assets would likely require some legislation to enable them for application to Tri-State assets.

Municipal electric utilities:

Municipal electric utilities (also called "public power") procure their electricity from wholesale suppliers and/or produce their own electricity in city-owned power plants. Municipal utilities own and operate their electric distribution system, and set rates to cover their costs **[9]**. Public power in most states, including Colorado, is usually cheaper than power from IOUs or co-ops, especially for the residential and commercial customer classes **[113,114]**, primarily because they are not-for-profit (unlike IOUs), and they have more customers per mile than most co-ops, and therefore have lower infrastructure costs per customer than co-ops.

Municipal utilities generally have more freedom to pursue their energy goals than co-ops, if their leadership chooses to exercise it and develops a plan. However, if cities pursuing 100% renewable energy goals own fossil-fueled power plants, they face similar decisions as IOUs about retiring them early, and replacing them with new renewable energy production or with wholesale power procurement from an independent power producer. These decisions have recently become more economically practical with the dramatic reduction in the cost of renewable energy and energy storage seen in the competitive bids received by Xcel in 2017 **[10,86]**.

Cost-competitive alternatives is a factor in the decision by Colorado Springs, the state's largest municipal electric utility, to close its downtown Martin Drake coal plant early. The retirement date was set in 2015 to be no later than 2035, then revised in 2017 to be 2023 **[119]**.

The Platte River Power Authority (PRPA) is a non-profit that produces and delivers wholesale power to the municipal utilities of four front range cities – Fort Collins, Loveland, Longmont, and Estes Park – which collectively own PRPA's

generation and transmission assets **[120]**. PRPA owns both fossil-fueled and renewable generation, and also acquires power through competitively-selected power purchase agreements. The two largest cities – Fort Collins and Longmont – have adopted the goal of 100% renewable electricity by 2030, and they are leading the effort to replace PRPA's coal generators with renewable energy **[121]**.

PRPA commissioned a study to evaluate the technical and economic feasibility of providing its owner-cities with carbon-neutral electricity, on a net annual basis, by 2030 **[122]**. "Net carbon-neutral electricity" is a slightly different and more precisely defined metric than "100% renewable electricity." The PRPA study still includes some use of natural gas generation to balance variable renewable generation, so carbon neutrality on a net annual basis is achieved by over-producing renewable energy and exporting the excess for sale in the regional power market to compensate for the amount of gas used.

Using very conservative assumptions, the study found that PRPA could provide net carbon-neutral electricity by 2030 for a cost premium of 8% over business-as-usual. While this small additional cost would likely be acceptable to the cities, the situation is actually much brighter when more realistic assumptions are considered, and the actual additional cost would almost certainly be near zero or even negative **[123]**. Actual median bids for renewable energy that were received by Xcel Energy in 2017 for deployment in 2023 **[51]** were lower than the assumed renewable energy costs used in the study even in 2030, by 26% for wind energy and by 10% for solar energy, and surely the prices bid to Xcel for 2023 will continue to decline through 2030. Furthermore, the study did not consider energy efficiency and demand response strategies that reduce the cost of replacement power by reducing both overall energy consumption and the peak demand, and Fort Collins is already a leader in these areas. Almost certainly, PRPA can reach net annual carbon-neutral electricity by 2030 for its four cities with no additional increase in electricity costs.

The PRPA study also did not include battery energy storage as an alternative to natural gas for daily balancing. Even now, batteries can cost-effectively replace gas generation in California by time-shifting excess mid-day solar generation to the peak demand period later in the day **[124]**. Battery storage and other types of energy storage under development will continue to decrease in price through 2030, and coupled with demand response to reduce the peak load, it is very likely that these will edge out gas for daily balancing by 2030, and reduce the need for PRPA to over-generate and export renewable energy in order to attain net carbon neutrality. However, it will still be necessary to address seasonal variability in both electricity demand and renewable electricity generation before the need for fossil fuels can be completely eliminated.

Showing that PRPA can provide something that could reasonably be characterized as "100% renewable energy" by 2030, cost effectively, is especially significant because PRPA owns some of the cheapest-to-operate coal generators in the country. If PRPA can do it, then so can other municipal utilities that have access to similar renewable resources, such as Colorado Springs.

5. CONCLUSIONS – A STAKEHOLDER PROCESS LED BY DECISION-MAKERS

Over one million Coloradans live in cities with an official goal of obtaining 100% of their electricity from renewable energy sources in the 5-15 year timeframe, but they have no cost-effective way to reach that goal. This large population could bring substantial pressure to bear to find a solution, if they coalesce around a common strategy.

Six approaches for cities to pursue ambitious energy goals were presented. Each approach would require some amount of state level legislative and regulatory action. The information presented about each approach is intended to provide sufficient background and a starting point for a transparent process that is led by decision-makers and informed by broad stakeholder input. The goal of the process would be to evaluate the possible approaches, craft a solution that is best for Coloradans, and then implement it.

The role of stakeholders is twofold: to call upon decision-makers to organize and initiate a public process that includes expert presenters and stakeholder input, and then to participate in the process of evaluating the options. Key stakeholders include: cities with energy goals; business interests; environmental and consumer advocates; utilities; independent power producers; and the general public.

Investigations should consider more than one single idea put forward by one set of narrow interests, because the best solution must arise from a thoughtful, deliberative, transparent process in order to be widely supported. Therefore, stakeholders are asked to reach out to their networks and share the message of calling upon decision-makers to initiate the needed open stakeholder process. Decision-makers need to hear the call from many different sources in different ways before they will perceive it as a priority that demands their attention.

The primary "Ask" of decision-makers is to initiate a transparent stakeholder process aimed at identifying the best solution that would allow businesses, cities and other jurisdictions to pursue their energy goals cost-effectively, identify the needed legislative and regulatory changes, and then implement the solution. This request is too reasonable and compelling to be ignored. Specifically, the "Ask" of decision-makers might involve initiating one or more of the following:

- A legislative interim committee (or other lawmaker-led forum)
- A Governor's select committee on community and corporate energy options
- An investigatory docket at the PUC (an I-docket or M-docket)

This project requires the participation of many diverse interests. The intent is for many people, acting together, to do the hard work of reaching decision-makers with the message that their leadership is needed. There is a place for all manner of contacts with decision-makers, including personal outreach, official requests from groups, and

newspaper opinion pieces by noted leaders and stakeholders of all types. There is also a role for the general public in all corners of the state, to "spread the word" and to contact Legislators and local officials via calls, emails, editorials, and questions posed at public meetings, City Councils, and Town Halls, asking for a transparent process to solve a problem that impacts well over a million of their constituents.

Cities and large corporate energy users are natural allies, with similar goals and similar constraints in monopoly IOU territory. Together they could apply greater pressure on utilities to address their energy goals, and greater political pressure on decision-makers to initiate a process to find the best solution(s).

The time is right to move this process forward. A large constituency of Colorado cities and businesses want cleaner and lower cost electricity, and renewable energy has reached, or will soon reach, cost parity with fossil fuel produced electricity. States without corporate choice options may have difficulty attracting and keeping energy intensive businesses. The Edison Electric Institute found that utility opposition to ambitious renewable energy goals is perceived by the public as "excuses" **[13]**. Citizens and stakeholders are in a better position than ever before to ask for what they want from their utilities, and forward-looking utilities will want to stay ahead of this customer demand to avoid having solutions they may see as undesirable forced upon them.

There is no substitute for a thoughtful, engaged, transparent, inclusive discussion of all the viable alternatives for reaching community and corporate energy goals.

About the author

This paper was written by Larry Miloshevich of Energy Freedom Colorado, a non-profit, volunteer organization that researches and advocates for the creation of competitive wholesale and retail electricity markets in Colorado. Many Energy Freedom Colorado members, and a few non-members, provided invaluable feedback that substantially improved the quality of this paper.

Rather than proposing any particular solution for reaching community or corporate energy goals, Energy Freedom Colorado believes it is important to have a wide-ranging discussion about electricity solutions for the 21st century in a forum where the best solutions can percolate to the top in an evidence-based process that involves all stakeholders, including the general public.

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