Solar Action Strategies

Actions Recommended to Achieve Local Renewable Energy Goals for 2020, 2030, and 2050 in the City of Boulder

City of Boulder

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Executive Summary

The Boulder Solar Strategy report is divided into two segments: (1) Solar Action Strategies, and (2) Solar Strategy Appendix.

This document is the first segment, Solar Action Strategies, which includes action-oriented strategies designed to move the City of Boulder towards its goals quickly. The Solar Strategy Appendix is a separate document which includes the selection criteria for the strategies; describes the process of final selection of strategies; provides specific results of supporting analysis; lists other strategies not prioritized in this report; and includes background material on the City's pending separation from Xcel and the municipalization process.

This Solar Action Strategies plan focuses on photovoltaic (PV) electricity generation and is divided into three phases (Phase 1: ending in 2020, Phase 2: ending in 2030, and Phase 3: ending in 2050). The plan is designed to meet the corresponding three local renewable electricity generation target goals (50MW, 100MW, 175MW respectively) as adopted on Dec. 7, 2016 by Boulder City Council[1].

The top solar strategy actions by phase are listed as follows:

Phase 1: 2020 Goal

Action #1. Launch a **Parallel Performance-Based Incentive** for qualified new local solar generation

Action #2. Lead a **Collaborative Portfolio Procurement** of new solar plus storage projects at City facilities, with an open-door option for other local public agencies to join

Phase 2: 2030 Goal

Action #1. Design and promote a **Standardized Green Lease** focused on commercial properties

Action #2. Initiate the development of a **Community Solar Garden** (CSG) on City property, enhance backing of local CSGs, and advocate to regulators for a local CSG capacity carve out

Phase 3: 2050 Goal

Action #1. Develop and release a **Feed-in Tariff** (municipalization scenario), or advocate for new wholesale solar rate structures as incentive (continued Xcel service scenario)

Action #2. Originate **PV + On-site Energy Storage** services contracts, and demonstrate installation at City Facilities

[1] *See Progress Indicators on page 22 of Boulder's Climate Commitment (https://bouldercolorado.gov/climate)*

Over 50 strategies were originally presented to City staff and to stakeholders from the community and University. This final plan recommends the top 10 programmatic actions (see Table 1 below).

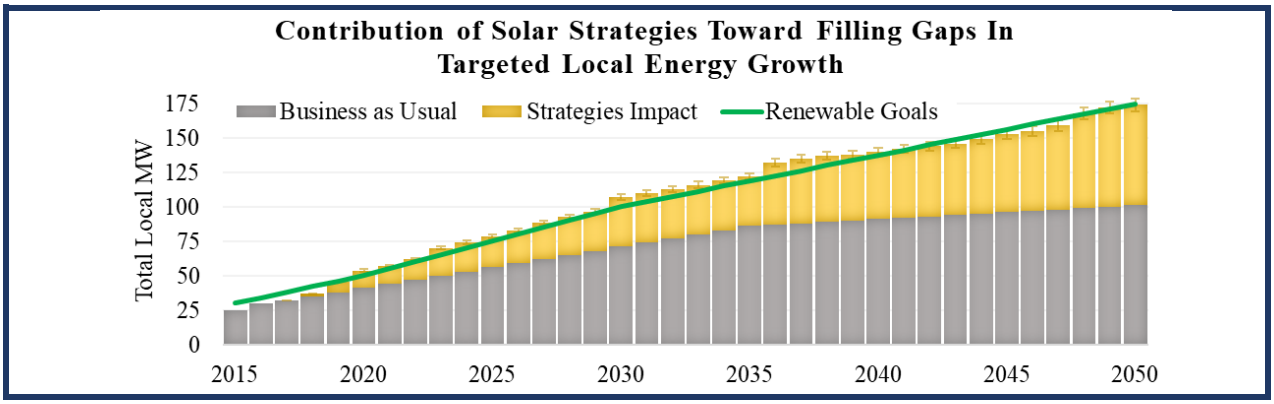
Table 1: Summary of Recommended Community-wide and City Facility Strategies

	Community-wide Impact Programs	**City Facility Programs**
Phase 1: Near-term Strategies for 2020 Goals	1. Parallel Performance-Based Incentive 2. One-Stop Solar Resource: Education, Outreach and Recognition	3. Collaborative Solar Procurement
Phase 2: Mid-term Strategies for 2030 Goals	1. Promote Green Lease for Commercial Buildings 2. Advocacy: Community Solar Gardens 3. Expanded Opportunities for Property Assessed Clean Energy (PACE) Financing	4. Community Solar Gardens on City Property
Phase 3: Long-term Strategies for 2050 Goals	1. Feed-in Tariff, or Advocacy for New Wholesale Tariffs 2. PV + Bulk Energy Storage	3. PV + On-Site Energy Storage Deployment

These strategies are needed to fill gaps in projected solar growth, and to stimulate the ongoing replacement and repair of aging locally-installed photovoltaic electricity generating systems. Figure 1 (following page) shows solar growth under a conservative business-as-usual (BAU) scenario, as well as the combined megawatt (MW) impacts of solar strategies needed to meet local energy targets. The forecasted BAU growth takes into account the end of life for typical PV systems after 25 years of operation, a recent International Trade Commission case, and the decreasing value of the investment tax credit for solar. BAU growth shows a projected slowdown at approximately four times the current solar penetration (~80MW total local solar) due to negative grid impacts of daytime over-production. Reductions in the financial savings associated with system installation are also projected to contribute to slow down of BAU growth as utilities shift toward higher production value during evening-weighted (forward shifted) time-of-use rates; this is a common practice for utilities with high penetration of solar generation.

The impact of each strategy has been modeled using best estimates based on current energy rates, solar project financing cost and financing availability, energy storage expected costs, and the previous program design and implementation experience of the Authors.

Figure 1: Filling Gaps in BAU Growth and Target Local Generation



A summary of program impacts is given in Table 2 (below) and Figure 2 (following page) which show starting capacity of local renewable electricity generating (including local hydroelectric generation) and subsequent solar growth. These megawatt targets are midpoint estimates, and final impacts to generation growth will vary based on the quantity of resources and staffing allocated and focused on specific program implementation.

Table 2: Summary of Potential Strategy Impacts as Modeled for this Strategy

Phase 1: 2018-2020		**Phase 2: 2021-2030**		**Phase 3: 2031-2050**	
Starting Capacity (2017)[2]	37	Starting Capacity (2017)	37	Starting Capacity (2017)	37
Planned/New BAU Capacity (2018-2020)[3]	7	Planned/New BAU Capacity (2018-2030)[4]	37	Planned/New BAU[5] Capacity (2018-2050)	64
Completed Strategies	0	Completed Strategies	6	Completed Strategies	26
Parallel Performance-Based Incentive	2.5	Continuing Phase 1 Programs	7	Continuing Phase 1 Programs	3
Collaborative Solar Procurement	3	Promote Green Lease for Commercial Buildings	4.5	Continuing Phase 2 Programs	12
One-Stop Solar Resource: Education, Outreach and Recognition	0.5	Advocacy: Community Solar Gardens (CSG)	3.5	New Tariffs and Wholesale Power Purchase Agreements (PPAs)	20
		Expanded PACE	3	PV + Bulk Energy Storage	10
		Community Solar on City Property	2	PV + On-site Energy Storage Deployment	3
Total	**50**	**Total**	**100**	**Total**	**175**

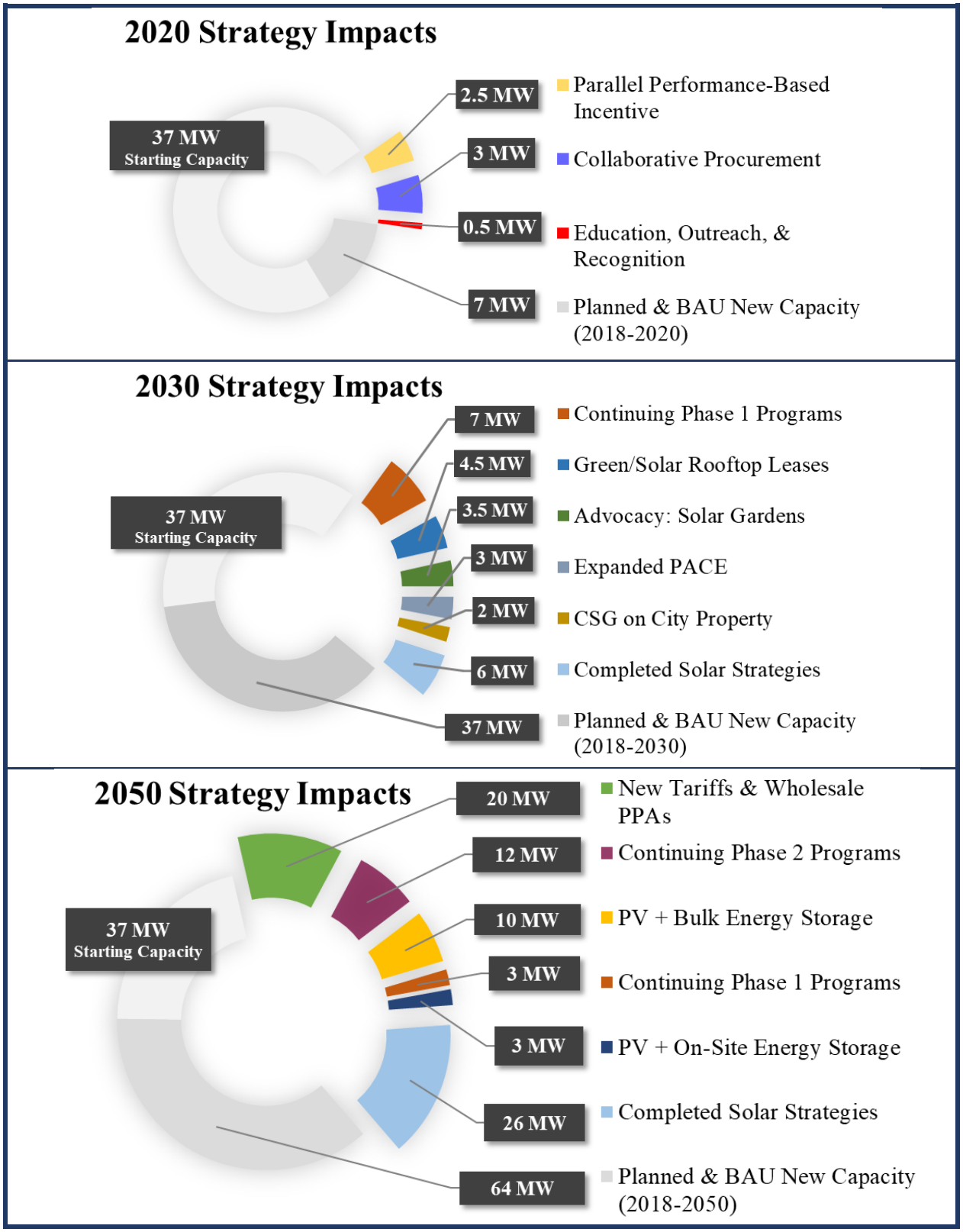
[2] Assumes 18MW of PV within City limits (permit data and Xcel community energy report), 2MW on University of Colorado campus, 1MW at City facilities in Boulder County, plus the City of Boulder hydroelectric capacity of 16MW

[3] Assumes 1MW normal continuing distributed PV growth plus 6MW of announced IBM facilities capacity (http://www.greenmatters.com/news/2017/11/30/2w1PvC/ibm-largest-solar-farm-boulder)

[4] Assumes municipalization will only trigger accelerated PV adoption by working within the proposed strategies

[5] Starting capacity in 2017 is nominally the same in all phases; the offset of system end of life beginning in 2030 is captured in the discounted BAU growth which allocates replaced systems as a continuation of 37MW starting capacity

Figure 2: Solar Strategy Megawatt Impacts for Phases 1 - 3



Confirming Solar Resource Feasibility

To confirm the technical feasibility of the solar goals (a prerequisite to the viability of the citywide solar strategy) the team surveyed potential solar photovoltaic (PV) capacity available on a random sample of structures within the city limits that did not yet have solar. Total potential rooftop solar siting capacity was identified at approximately 500 MW; this estimate includes deductions for shading limitations and rooftop usage restrictions such as walkways, equipment, and sloped or inefficient orientations. This result validates earlier National Renewable Energy Laboratory (NREL) estimates using Light Detection and Ranging (LIDAR) imaging to identify siting capacity, and the results in the Mapdwell Boulder Solar Tool[6]. As a result, the Authors conclude that the 2050 goal of 175MW of total local generation is highly feasible. A strong prevalence of siting potential in the medium system size (typically commercial and industrial buildings) alone was sufficient to meet the total goal of 175MW by 2050 (see Table 3).

Table 3. Summary Results of Citywide Rooftop Solar Potential (PV system size categories follow interconnection level tiers from Xcel Energy)

Building and System Size	Number of Structures	Average System Size (kW-peak)	Solar Potential (MW-peak)	Contribution to Total Potential
Small, under 10kW	16,000+	7	116	23%
Medium, 11 - 250kW	9,000+	40	315	63%
Large, over 250kW	600+	110	68	14%

Solar actions and feasibility for specific City-owned facilities were similarly evaluated. Solar planning maps were developed for most City properties. Sites were marked by installation type (parking lot, ground-mount, or rooftop), modeled by PV system size, and ranked by favorable solar suitability ("A", "B", and "C"). For many of these sites pre-design plans were completed, totaling roughly 20MW of solar capacity at City-owned facilities.

The list and rankings of City-owned sites, the citywide survey methodology, and the full details of the mapping results are presented in the Appendix.

[6] *https://www.mapdwell.com/en/solar/boulder*

Treatment of Renewable Energy Certificates

Renewable Energy Certificates (RECs) are the rights to claim environmental benefits from renewable energy projects. REC prices have declined nationally in key markets in recent years and it is likely that by 2050 an expansion of low-cost renewable generation will eliminate the value of selling RECs[7]. Although the City of Boulder desires to own and retire RECs produced from its local renewable generation, financial incentives currently limit the practicality of the City retaining RECs under the continued Xcel service scenario. For near-term projects using a modeled 25-year PV system lifetime, with an initial REC value of $30/MWh and declining to $10/MWh over this same period, a hypothetical 1MW City-owned PV project at an industry-averaged total system cost of $1.77M would receive a discount of approximately 40% of this cost recovered through revenues from REC sales to the utility or other offtaker. In practical terms this reduction in cost increases the City's ability to deploy solar by 67%. For the specific "B" and "C" ranked City facilities (approximately 3MW of total potential capacity) these sites may only be financially viable if RECs are sold (under the current Xcel service scenario). In addition, existing Xcel renewable incentive programs continue to require that the utility receive ownership of RECs in exchange for the financial considerations associated with the programs.

In 2016 the electric energy portfolio supplied by Xcel to the City and its residents was a mix of 47% coal, 26% natural gas, and 29% clean sources[8]. This solar action strategy accepts that under the continued Xcel service scenario, substitution of local solar energy in place of the Xcel energy mix is the primary and most effective method for achieving the community's goals. Thus, for the purposes of meeting Boulder's Climate Commitment, any increase in local renewable generation will provide a proportionate reduction in the amount of energy serving Boulder from outside sources and may therefore be legitimately counted toward achieving carbon reductions, whether Xcel, the City, or private parties retain the RECs. Nonetheless, the long-term commitment is to an unambiguously clean energy supply with ownership of RECs remaining the ultimate goal by 2050. For the purposes of discussing strategies in this report all RECs produced under the continued Xcel service scenario are assumed to be sold prior to 2050, and retained after 2050 in support of Boulder's Climate Commitment.

Under the municipalization scenario the City is required to retire RECs for compliance with State of Colorado Electric Rules, 4 CCR 723-3[9]. Retaining locally-sourced RECs which qualify for the community-based project multiplier is an effective way to meet both the State's Renewable Energy Standard (RES) and the City's local generation targets (1.0 MWh of generation from a community-based project is counted as 1.5 MWh for RES compliance purposes). According to current RES rules, the launch of a municipal electric utility in 2023 would mandate REC retirement equivalent to a total retail sales fraction of 1% in 2024-2026; 3% in 2027-2030; 6% in 2031-2035; and a requirement of 10% thereafter. If the City's hydroelectric RECs are retained, and a current forecast of population growth is extended to the year 2036 with stable per capita electric usage, analysis suggests that roughly 50MW of PV under City REC control would provide RES compliance; without hydroelectric RECs the City's estimate rises to roughly 85MW of REC-controlled PV.[10]

[7] *https://news.energysage.com/srec-prices-explaining-u-s-srec-solar-market/*
[8] *See Annual Community Energy Report by Xcel Energy in the Appendix*
[9] *https://www.colorado.gov/pacific/dora/electricrules*
[10] *Assuming the continued availability of the community-based projects 1.5 multiplier*

Municipalization Considerations

Strategies presented in this report have been designed to operate under the incumbent regulated utility or to integrate with the City's efforts to form a municipal electric utility ("municipalization"). Under all scenarios, municipalization would magnify the impact of the proposed strategies and facilitate the ease of implementation. Specific divisions in actions that depend on the results of municipalization are called out when needed. The benefits of municipalization fall primarily on the City's independence in setting rates, structuring tariffs, innovating new policies, and developing new programs to support solar growth and climate goals.

By gaining control of a physical network, which allows the transport and measurement of energy between generating stations and load centers, municipalization overcomes a key barrier in solar dispatchability and potentially enables a more open market for the accompanying financial transactions between producers and consumers. Although municipalization alone does not specifically address the current cost barriers of PV system construction, or the inherent solar challenges of midday over-generation and seasonal production differentials, it is an important empowerment toward clean energy planning and this report recommends the continuation of municipalization efforts.

Phase 1 - Strategy 1:
Parallel Performance-Based Incentive (PBI)

Target Impact on New Generation by 2020	2.5 MW
Technical Challenges	3.5/10
Administrative Burden:	
Design and Launch	1.2 Full-Time Equivalent (FTE) + $90,000 outsourced support
Ongoing Administration and Customer Care	0.10 FTE + $30,000/year outsourced support
Difficulty to Transfer to Muni Utility	1/10

In addition to incentives already offered by the City, State and federal governments, a parallel Performance-Based Incentive (PBI) program can be implemented by the City as a financial driver to overcome low energy-offset savings on Xcel commercial rates (SG/PG). Key benefits of a performance-based incentive are:

1. Offers price discovery and value specifically to the "local" attribute of local generation
2. The incentive may be financed through the City's allocation of the Energy Impact Offset Fund in initial years
3. Requires owners to monitor and maintain systems, ensuring effective use of subsidy
4. Increases visibility of local generation information from system owners when they share monitoring data with City
5. Can be offered for entire system lifetime (adds assurance for lifetime maintenance and operation) or for critical system payback period only (e.g. first 5-7 years)
6. Can be offered at different tiers for residents with low income or for multi-family and condominiums
7. Are paid in the future rather than in advance (PBI budget allocations can earn interest for the City while waiting to be paid out to recipients)
8. PBI price is controlled by City program manager and can be increased or decreased (by annual vintages) to drive deployments as needed
9. Drives "tipping-point" commercial projects, especially PPA projects and rooftop solar lease

Incentive Level: An incentive should be targeted as the minimum amount sufficient to push marginal projects into viability, or to decrease payback periods down to common consumer comfort levels (5-7 years). For commercial targets, the minimum incentive should cover the increased marginal cost which commercial developers bear when constructing on rooftops as

opposed to ground-mounted systems. Typical rooftop solar leases bear an internal cost of $0.16 per square foot for the use of the roof space as an annual lease[11]; this translates to an incremental energy cost-adder of roughly $0.01/kWh required by the developer for financial project viability. The upper extreme of incentives (e.g., over $0.05/kWh) for exported energy are likely to drive quick development but require substantial investment and may be less efficient on a dollar-per-MW basis of stimulated growth.

It is possible that program participants can authorize the program managers to use Xcel Green Button data or Electronic Data Interchange (EDI) to obtain PV production data from systems with Xcel-owned export meters, such as at Community Solar Gardens. For net-metered customers, participation in the incentive program would require third-party monitoring and reporting equipment to make the PV production data available to City and program managers. Since performance monitoring is a best practice for system installation, the City's requirement would simultaneously improve ongoing generation oversight for participating PBI recipients.

Early in the program design process, Boulder should work to define target customer groups to benefit from a PBI and offer targeted incentives on a rolling basis to provide financing support based on defined goals, such as social equity or non-profit status. If PBI program sign-ups exceed budget allowances, setting caps on enrollment rounds may be necessary or need to be facilitated by lottery or another selection/waitlist process.

A PBI program is expected to be relatively administratively burdensome due to customer care requirements and data-tracking of PV production and credits. A third-party organization may be used to assist the appropriate City department with tracking and payment of incentives (much like CLEAResult already handles the EnergySmart program for the City).

ACTION PLAN

2018: Design program and gather feedback, seek City Council approval and financing

1. Identify customer segments and property types to target for the incentive
2. Consider the feasibility of using a City facility as pilot demonstration project
3. Assemble an internal team (Energy Future, Energy Strategy and Electric Utility Development) and work with a subcommittee of the Solar Working Group (and/or past Rates Working Group members) to design acceptable target outcomes for the PBI, as wells as the necessary metrics for evaluating the success of the PBI
4. Create an aggregate system performance and finance simulation model for the program
5. Identify program guidelines, as well as potential risks and legal protections for the City
6. Finalize necessary incentive level (or tiered levels).
7. Model required capital needs
8. Secure funding (if Energy Impact Offset Fund is unavailable, locate alternate financing)
9. Seek and obtain City Council approval

[11] *Based on privileged conversations with many of the largest US commercial property management corporations*

2019: Test and launch program

1. Draft program guidebook, website information pages, and rules of the PBI
2. Solicit participants
3. Run a pilot program for two months, potentially with a City facility
4. Finalize program guidebook, website information pages, and rules of the PBI
5. At-scale public launch

Strategy Rationale

- Incentives for multi-family and commercial and industrial (C&I) sectors will improve the economics of marginal new solar installations, resulting in more projects sooner

Keys to Success

- Requiring shared monitoring of customer production data
- An incentive that is large enough to interest major C&I customers
- Consistent customer care and incentive payment routing

Cost Impacts to the City

- 1.2 FTE + $90,000 outsourced for program design and launch
- 0.10 FTE + $30,000 outsourced at-scale customer care and program administration
- Plus incentive budget (per MW of qualifying new construction) paid for 5 years:
    - PBI of $0.02 cents/kWh; $30,000 annual; $150,000 total
    - PBI of $0.03 cents/kWh; $45,000 annual; $225,000 total
    - PBI of $0.04 cents/kWh; $60,000 annual; $300,000 total
    - PBI of $0.05 cents/kWh; $75,000 annual; $450,000 total
    - PBI of $0.06 cents/kWh; $90,000 annual; $525,000 total

Phase 1 - Strategy 2:
One-Stop Solar Resource Center

Target Impact on New Generation by 2020	0.25 – 1.0 MW Near-term direct impacts will be small; however, it serves as a hub at the intersection of several other strategies
Technical Challenges	2/10
Administrative Burden to City	0.25 – 1.5 FTE Starts with minimal staffing in Phase 1 and grows as programs are implemented (this includes both direct solar resource center programs such as progress notices and recognition events, but also supports education around PBI, collaborative procurement, etc.); possible outsourcing costs in Phase 2-3
Difficulty to Transfer to Muni Utility	1/10 City would continue to manage

A comprehensive (one-stop) solar shop would consolidate solar information, outreach, education, recognition, and data into a single office with a managed online platform. The primary purpose is to make it easier for residential and commercial property owners to better understand the costs and benefits of solar PV systems. This resource would allow residents and businesses to quickly connect with a trusted advisor to review information on their property's solar PV potential (i.e., encouragement to use and improve the Boulder Solar Tool), to find local solar installers, locate total rebates and incentives, compare costs and benefits of solar PV systems, evaluate leasing versus purchasing a solar PV system, and assess the value of a Community Solar Garden subscription versus adding rooftop solar PV on their business or residence.

In communications with Boulder community stakeholders, the need and desire for such a support system for local residents and businesses was clearly and consistently indicated. Additionally, discussions with representatives from cities and counties across the West indicate that an active web presence that is optimized for mobile devices, and focused on renewable energy content, will drive participation in local renewable energy programs.

As a mixture of education, outreach, engagement, data transparency, and project demonstration, a one-stop platform would continue unchanged after the City's municipal electric utility is operational. Solar education and outreach programs support and enable technology-heavy programs such as community solar gardens or solar leases for home-owner association (HOA) and

commercial rooftops by educating citizens and businesses about direct benefits they can gain through local renewable energy projects and programs.

The one-stop resource center would help direct public recognition and rewards targeted at residential, commercial and industrial customers who add solar PV to their properties. Recognition can lead to more exposure to the success of solar projects, which leads to greater market penetration for PV as homeowners and businesses follow successful examples among peer groups. To focus attention on peer-to-peer recognition, recognition programs could be facilitated by the City's resource center but awarded by a business trade group or citizens' organization. Low-tech strategies, such as a "progress thermometer" showing local movement towards City goals, placed on a wooden sign in the City center, could similarly recognize progress and spur development. The one-stop resource center has been recommended as a Phase 1 strategy since information and outreach is complementary to most all other strategies contained in this document. As such, early attention should be paid to budget prioritization of the centralized information resource center for the integrated benefit of the overall strategy.

This plan recommends early education focused on the relationships between local energy, transportation, and electric vehicles (EVs). This is important since changing State goals will push EV uptake in the coming years and create opportunities for integrating solar generation with the transportation sector. An effective education and outreach (E&O) program will also include efforts across broad categories (see Appendix for a more extensive list of opportunities), however, solar education and outreach elements can be grouped into the following five primary categories:

1. Hosting regular meetings and special events
2. Maintenance of a curated hub for phone and online education resources and calendar of events
3. Technology and financing issue-specific campaigns
4. Recognition campaigns and events
5. Recurring outreach products:
    - Annual publication on energy target progress
    - Monthly newsletter (Public Utilities Commission updates, percentage of local energy content delivered, etc.)
    - Internet-based solar outreach (website promotion, social media, targeted emails)

All of these programs can be combined to help the City of Boulder educate, inform and mobilize the business community, potential public-sector partners, local universities, and residential customers.

Outreach programs should be internally reviewed to track and measure the impact of each initiative toward the City's goals. Specific website metrics (interaction, click through, etc.) should be pulled and reviewed. Sign-in lists and headcounts should be used for all in-person events.

Outsourcing of community outreach and education should be considered to engage experts in solar purchasing or behavioral change programs to maximize real-world support and positive impacts through proven strategies and techniques. Recent advances in behavior change science make these

programs an increasingly important asset to municipal utilities and cities for supporting the adoption of renewable energy.

ACTION PLAN

2017-2018: Define goals and staff capacity requirements

1. Create roadmap and priority for one-stop resource objectives (e.g. short-term support for launching solar strategy programs, mid-term support for progress updates and recognition, long-term support for municipalization transition)
2. Clarify budget and funding opportunities
3. Identify staff
4. Choose prioritized target populations for outreach (commercial, industrial, residential, institutional)
5. Establish outreach partnerships with key local organizations (business groups and non-profit)

2019-2050: Ongoing implementation

1. Develop customer care website with appropriate features (instant-message support, consumer reviews, key resource links, frequently-asked questions, etc.)
2. Design a customer relationship management (CRM) platform to track target segments and strategically communicate events and programs as they become available
3. Identify and replicate existing municipalization and clean energy educational best practices and industry expertise
4. Contract with a third-party behavior change provider to drive solar awareness and lifestyle adaptation toward conservation and electrification

Strategy Rationale

- Dedicated staff and information all at a single resource center help unify efforts across multiple interventions and programs
- Public recognition and rewards to Boulder residents and businesses can drive greater PV market penetration

Keys to Success

- Overcoming inertia through targeted outreach programs
- Combining solar E&O programs with energy efficiency programs, including Zero Net Energy initiatives
- Measuring the impact of outgoing solar E&O messages
- Budget commitment from City management
- Leveraging University and private sector sustainability E&O dollars through partnerships

Cost Impacts to the City

- Costs can range from 0.25 – 1.5 FTE in Phase 1; in later phases likely $100,000 additional for outsourcing of interactive web features (e.g. real-time citywide solar monitoring) or marketing, behavior and brand analysts
- If staff for the resource center can be provided through shared budgets among existing or planned initiatives, additional allocations may be minimized

Major Barriers

- Tracking solar MW directly or indirectly attributable to these programs may be difficult
- Funding barriers can be significant, since solar E&O programs are often deemed "soft"

Phase 1 - Strategy 3: Collaborative Solar Procurement

Target Impact on New Generation by 2020	2-5 MW
Technical Challenges	5/10
Administrative Burden to City	1.5 FTE
Difficulty to Transfer to Muni Utility	2/10

In the past, the City's approach to placing solar at City facilities has been to consider proposals on a case-by-case basis. Collaborative solar procurement is an alternate means by which the City of Boulder can coordinate a single procurement effort across multiple sites and with cooperative public or private entities. By pooling purchasing power and expertise under a lead agency, this type of collaborative initiative enables its participants to publish a single RFP, purchase large volumes of solar PV panels at prices often 10 to 14-percent lower than if purchasing individually, and negotiate better contract terms for the installation and maintenance of the systems across numerous locations.[12]

Colorado municipalities already purchase various commodities collaboratively such as road signage, fleet vehicle parts and many others. The City of Boulder has collaboratively purchased commodities with the City of Denver in order to save money.[13] In many ways, a group solar purchasing initiative would work the same way, but with specific desired outcomes at specified sites, both those owned by the City of Boulder and those owned by partner agencies. A solar purchasing collaborative led by Boulder will be most effective if it first develops a comprehensive plan to install solar across a portfolio of City facilities based on the Authors' findings and analyses concerning the solar potential at individual facilities (see Appendix). The City can then use its own procurement plans to recruit potential public or private partners with their own portfolios of possible solar sites. Leveraging existing local initiatives to strengthen community resilience planning with Boulder County can be a first step in this outreach effort.

Overall success of a multi-agency solar procurement depends on the number and engagement of partners recruited for the purchasing collaborative and the volume of their individual potential solar portfolios. Regardless of the number of participating government entities, one serves as the lead, or "lead agency", and will typically face higher administrative costs in fulfilling that role, centering around significant staff-time contributions toward development and management of procurement documents and negotiation of contract documents. The lead agency may also serve as a "convener", using existing relationships to bring together potential collaborative partners.[14]

There are several local governments in close proximity to the City of Boulder that are clearly attractive potential partners (including Boulder County, Boulder Valley School District, the

[12] *Goodward, Jenna, Rachel Massaro, Benjamin Foster, and Caroline Judy. 2011.* Purchasing Power: Best Practices Guide for Collaborative Solar Procurement. *Washington, DC: World Resources Institute.*
[13] *Interview with Dave Bannon, City of Boulder Purchasing Manager, during project kick-off meeting, July 18, 2017*
[14] *Ibid*

University of Colorado, and the cities of Denver, Fort Collins and Longmont) because of their respective solar and/or clean energy targets. In addition to increased vendor interest and more competitive pricing, collaborative procurement has also demonstrated savings in staff-time requirements and the time it takes to go from project inception to completion. Two examples of municipal collaborative procurement follow:

> Alameda County (CA) led a group of 19 governmental agencies in four counties across the San Francisco Bay Area to solicit 31 megawatts (MW) of renewable energy at 187 separate locations. Participants are expected to save $108 million and projects are expected to generate $70 million in local economic activity. This Regional Renewable Energy Procurement Project (R-REP) is the largest multi-agency collaborative solar procurement to date.[15]
>
> The Silicon Valley Renewable Energy Project (SV-REP) sought to procure more than 14 MW of solar capacity at over 40 municipal facilities throughout Santa Clara County (CA) and the nearby region.[16] This initiative led to the authoring and publication of a guide to best practices and lessons learned for such a multi-agency solar procurement.[17]

The collaborative procurement model can also be customized to provide the City of Boulder with the ability to help reduce barriers to entry for potential partners through the use of a revolving fund. If the City is willing to use its own funds to cover the upfront costs of solar assessments, RFP/RFQ development, and vendor evaluations for potential partners, those partners may be more likely to collaborate. As a condition of participation, the City can require that partner agencies agree to reimburse, or require their solar installers to reimburse, the City a small percentage of project costs, if and when projects are successfully constructed. These reimbursed funds can then be used by the City for future solar procurements or other regional clean energy initiatives. This revolving fund concept has been applied to regional purchases of municipal solar PV projects like the Sustainable Energy and Economic Development Fund (SEED Fund),[18] which have deferred upfront allocation of funds for project planning, site assessments, or procurement activities. These costs have been paid back through solar contracts that are developed with vendors through a dedicated fund, whose reimbursements then pay for upfront costs for the subsequent round of the public procurement (see Appendix for more information). By removing the initial financial barriers to entry for potential partners, the City of Boulder may be able to achieve better and more effective collaboration, and, subsequently, a more successful procurement.

[15] *https://www.acgov.org/rrep/progress.htm*
[16] *https://jointventure.org/initiatives/completed-initiatives/solar-procurement/sv-rep*
[17] Goodward, et al., *Purchasing Power*
[18] *http://www.solarroadmap.com/regional-initiatives/seed/*

ACTION PLAN (adapted from the best-practices guide)[19,20]

2018: Convene group and compile sites for solar procurement

1. Conduct regional recruitment of potential participants in joint procurement through lead agency and/or convener
2. Distribute agency and site questionnaire to gather necessary information and data for project implementation
3. Offer solar project workshops with relevant stakeholders including partner agencies, consultants and staff, to build understanding and collaboration
4. Determine desire for, and structure around, revolving fund
5. Perform detailed site analysis
6. Obtain approval from internal decision makers
7. Develop procurement process and RFP documents
8. Issue RFP to solicit project proposals
9. Evaluate proposals

2019: Selection and Construction

1. Negotiate contract terms and make formal awards to vendors
2. Approve and oversee design, engineering, and construction
3. If revolving fund is used, invoice for reimbursement from participating agencies
4. Commission systems and monitor operation

[19] *Id.., 15*
[20] *https://jointventure.org/images/stories/pdf/best_practices_collaborative_solar_*

Strategy Rationale

- Collaborative procurement can drive down costs and help attract outside capital for project finance due to joint partnership among agencies. Collaboration also lowers the administrative burden and costs of solar siting, sizing and project analysis for involved stakeholders and can accelerate the process of implementation.

Keys to Success:

- Strong partnerships and willing stakeholders able to see a joint project go from design to implementation
- Legally solid contract terms and conditions of success
- Good project management and support to clearly define milestones and consensus across diverse stakeholders and project partners

Costs to the City:

- Staff-time equivalent to 1.5 FTE for 18 months, plus possible external costs for site assessment and procurement management
- Lower than one-of-a-kind projects
- May include outside consultant or project management fees to bring together stakeholders and navigate planning and implementation
- If purchased by the City, an estimated 20 MW on City facilities would cost $30-50 million; financed options, such as PPA or lease, could require no money out-of-pocket

Major Barriers:

- Institutional inertia related to facility usage
- Organizational and motivational hurdles in managing multiple agencies and their staffs
- Contracting with equipment suppliers and price negotiation

Phase 2 - Strategy 1:
Green Leases and Solar Rooftop Leases

Target Impact on New Generation by 2030	4.5 MW
Technical Challenges	4/10
Administrative Burden to City	0.5 FTE
Difficulty to Transfer to Muni Utility	1/10
	Stays inside sustainability, building, planning departments

A green lease is an effective approach to overcoming the common split-incentive barrier that exists between building owners and their tenants, where neither has a financial incentive to make energy efficiency or renewable energy investments. Either party can initiate the process of negotiating various clean energy investments to the property, which can ultimately benefit both parties, through a lease payment made to a landlord and energy savings that accrue to a tenant or group of tenants. Other related example strategies that the City can promote include sub-metering of tenant utilities, versus a monthly flat utility payment or no payment at all. Alternative models include a landlord and tenant sharing the utility bill so that the landlord can capture some of the tax advantages associated with investing in solar PV.

Property owners benefit under a green lease by demonstrating that they can be flexible with tenants, allowing them to pursue their own climate objectives, profit from improvements, garner community recognition for their efforts, attain building energy and environmental certifications, comply with Boulder's Building Performance Ordinance, and ultimately increase the value of their properties.

Working through property managers and the Boulder Chamber of Commerce to develop and promote standard rooftop solar lease / green lease contract language would expand benefits across a wide-variety of building sizes, number of tenants, and uses such as office space, light manufacturing or mixed use.

Given the high demand for commercial property space in Boulder, the high market values of those properties, and the high percentage of leased properties, the proliferation of Green Leases has the potential to increase the installation of solar PV, whether rooftop or through Community Solar Gardens, as well as other emerging clean energy.

The primary approach where the City can promote Green Leases is to utilize the annual Rating and Reporting protocol established by the commercial Building Performance Ordinance (BPO) that directs property owners to share energy usage and cost data with tenants on an annual basis. At a minimum, property owners could use the Green Lease to make BPO compliance more cost effective by creating a financial incentive for tenants to reduce energy consumption. The process can also lead to other clean energy investments such as solar. Furthermore, once energy data is

shared publicly as required by the BPO, building owners will be able to showcase their building's clean energy attributes for marketing purposes.

The City can impact the market by supporting and facilitating a Green Lease pilot program at several sites with different uses (retail, light manufacturing, mixed use, etc.), square footage, and rooftop solar PV potential. The Rocky Mountain Institute (RMI), an internationally-recognized expert on market transformation tools such as a Green Leases, will be the anchor tenant of the new 100,000 square-foot Boulder Commons project. RMI negotiated a Net-Zero Lease with the building owner, the terms of which establish an energy budget for RMI, which it is incentivized to closely manage and control or be penalized, allowing the developer to optimize the size of a rooftop solar PV system. As part of its 2017 Boulder Energy Challenge award, RMI will be launching a training and outreach campaign for property owners and tenants on Net Zero Leases. The City should collaborate with RMI on such outreach efforts and utilize their expertise to identify opportunities for Green Leases as well.

The City can also work with large commercial property owners to help structure corporate gross leases that allow the developer to pay the tenants' utility bills in addition to paying the building's property taxes, maintenance and operating expenses. The pilot could include a lease that is written to cover a specific portion (e.g., 50%) of the annual electricity consumption (kWh/year) so the property owner's exposure to the split incentive issue is minimized. The developer then can be incented to invest in solar PV and receive the tax benefits, in addition to lowering operating expenses.

In addition to Green Leases solar rooftop leases are a common way to access rooftop solar options under the split incentive. Property managers have a strong base of understanding in recurring payments for access to space, but less experience or interest in solar deployment. The solar rooftop lease brings the financial terms of solar development into terms with which the property managers are familiar and comfortable.

Lastly, the City should develop a policy requiring City Departments that are leasing space, or will be leasing space, to initiate a discussion with property owners about entering into a Green Lease to aid in achieving Climate Commitment goals and objectives where cost-effective.

Because education and outreach are key to this market transformation strategy, the City should consider publishing materials such as a Green Tenant Guidebook[21] that provides information and technical assistance to tenants about how they can achieve various sustainability goals and objectives in Boulder, including the pursuit of Green Leases.

ACTION PLAN

2020: Begin planning of lease pilots

1. Incorporate green lease discussions into the commercial Building Performance Ordinance's annual Rating and Reporting protocol to begin at next meeting and target outreach to large property owners.

[21] *For example, the City of Portland's Bureau of Planning and Sustainability publishes a Green Tenant Guidebook to aid tenants address their various sustainability goals and objectives: https://www.portlandoregon.gov/bps/article/285215*

2. Principal focus should be on information-sharing and technical assistance, not additional regulations. If the City wants to require building owners and tenants to discuss the potential of a green lease as part of their annual energy usage and cost information sharing, it will need to develop a timeline to amend the current Building Performance Ordinance. This would require minimal City of Boulder staff time and effort and would likely face little opposition from stakeholders as the ultimate decision to proceed with a lease would be voluntary.
3. Alternatively, or in coordination, the City could implement an education and outreach initiative that parallels the existing training program being developed by RMI which targets property owners and tenants with information on the benefits of installing solar PV.

2021: Begin implementation of lease pilots

1. In year two, consider organizing a green lease pilot program at several commercial properties
2. Solicit input from key partners about the scope and desired outcomes of a green lease pilot
3. Based on available commercial building energy use data and leases, identify potential pilot projects that incorporate commercial property owners or companies

2022: Publish standardized lease

1. Adopt a policy for City Departments that lease space to engage property owners about green leases as a means to install solar PV where cost-effective to the City and taxpayers.
2. Work with the Finance Department to develop language for internal policy. Developing and implementing the policy would require a minimal amount of staff time and effort.
3. List program details on One-Stop Solar Resource site and consider map of existing green leases and roll into tools like Mapdwell or City website to be used as a business development tool

Strategy Rationale

- Green leases and solar rooftop leases can help solve split-incentive issues, while facilitating landlord compliance with Boulder's existing Building Performance Ordinance

Keys to Success

- Quantifying the potential for green leases across the commercial sector
- Participation and support from key private partners
- Informational resources such as detailed case studies and template documents

Cost Impacts to the City

- Fiscal impact to the City will be minor, largely educational materials and outreach
- If the City desires to amend the commercial BPO to incorporate discussion of green leases, expect minimal additional staff time

Major Barriers

- Property turnover rates are high due to real estate speculation
- Credit worthiness of property owners and tenants
- Length of lease terms

Phase 2 - Strategy 2:
Advocacy for Community Solar Gardens

Target Impact on New Generation by 2030	3.5 MW
Technical Challenges	5/10
Administrative Burden to City	1-2 FTE +outsourcing[22]
Difficulty to Transfer to Muni Utility	8/10 Complicated transfer to muni and risk of stranded assets inside muni grid that must wheel power to Xcel

Community solar Gardens (CSG) offer property owners with limited ability to install their own solar PV system the ability to access the benefits of renewables through subscriptions to large solar arrays constructed in off-site locations. CSG can also serve as a conduit for the City of Boulder to provide greater access to renewable energy to property owners with low-to-moderate incomes. The model offsets traditionally high up-front costs of solar by spreading the investment among many participants or by spreading the ongoing costs of energy among multiple subscribers. It makes solar more affordable by allowing for economies of scale in construction and installation, access to federal tax incentives, and, often, by using open land instead of existing structures. A Community Solar initiative can operate with Boulder as a citywide customer of Xcel Energy, or could be replicated by the City as part of Boulder's municipalization effort. The impact in terms of total MW potential of Community Solar increases greatly under municipalization.

The future viability of solar gardens depends on sustainable bill credit rates given by the Xcel tariff calculation. Solar garden bill credit rates have experienced a continued compounding annual decrease of 2-3% over the past years and continue to fall.[23] Advocacy for solar gardens should include broad advocacy for a sustained or alternative energy delivery credit mechanism such as initiatives to:

1. Designate a solar gardens carveout for City of Boulder or Boulder County
2. Secure the continued availability of net energy metering (NEM) for utility customers
3. Allow for other non-CSG virtual net metering (VNEM) mechanisms
4. Codify rules for over-the-fence, or direct peer-to-peer electricity sales

[22] This determination is uncertain since the City regularly employs advocacy and legal outsourced and internal experts; potentially $175,000 of legal and regulatory advocacy costs; creation of marketing and design of a City-controlled CSG program is likely to cost $100,000 at launch, with $25,000 in annual program management costs
[23] Analysis by Matt Lehrman and source data https://www.xcelenergy.com/company/rates_and_ regulations/rates/solar_rewards_community_service_tariff

ACTION PLAN

2020-2025: Regulatory intervention

1. Define scope and priorities for lobbyist and attorneys (CSG carve out, VNEM alternatives, over-the-fence)
2. Add one-stop resources and community engagement event to support lobbying activities
3. Begin legislative outreach and regulatory intervention

2025-2030: Local Advocacy

1. Identify potential local host sites for CSG
2. Advocate to solar developers for reduced-cost "predevelopment" activities similar to collaborative procurement site assessments
3. Quantify role of local incentives in successful CSG initiative
4. Liaise with Boulder County staff to discuss new CSG opportunities outside of the City limits; compare project tradeoffs based on costs, total generation capacity, and desire for new local renewable generation

Strategy Rationale

- Community Solar Gardens enable large-scale solar installations with renewable benefits that can accrue to targeted subscribers who may otherwise be unable or unlikely to have access to renewable energy

Keys to Success

- Access to Xcel Energy Solar*Rewards offerings
- Available and affordable land (or large rooftops) in Boulder
- An experienced developer partner or partners

Cost Impacts to the City

- Costs are mostly associated with setting up program and tracking customers and RECs
- A separate incentive payment could be paid by the City to a developer
- Ground-mounted Community Solar projects typically cost $1.5-2 million per MW

Major Barriers

- The price and availability of a piece of land large enough to host a project. Typically, a 1-MW system requires roughly six acres and costs around $1.5-2 million
- Customers are limited to purchasing no more than 120-percent of their power needs from a Community Solar project and the very limited statewide size of the Xcel Energy Community Solar pool (60 MW currently)
- The City cannot benefit from federal solar tax credits such as the Investment Tax Credit (ITC) and depreciation
- Ownership of the Renewable Energy Credits (RECs) for a Community Solar program requires special attention

Phase 2 - Strategy 3:
Promote C-PACE and Advocate for Expansion

Target Impact on New Generation by 2030	3 MW
Technical Challenges	4/10
Administrative Burden to City FTE	.25 FTE
Difficulty to Transfer to Muni Utility	6/10

Launched in 2016, Colorado's Commercial Property Assessed Clean Energy (C-PACE) program allows multi-family, non-profit, commercial and industrial property owners to finance eligible renewable energy, energy efficiency and water efficiency improvements at new or existing properties. The financing mechanism allows improvements made by the property owner to be repaid through a voluntary tax assessment placed on the property over a 5-20 year term that is paid to the County. A benefit of C-PACE financing is that the terms of the financing remain with the property. This proposed strategy looks at enhancing C-PACE and legislative advocacy for expanding property assessed clean energy beyond the commercial markets.

As of August 2017, three commercial properties in Boulder County (two within the City of Boulder) have finalized C-PACE financing for projects that include solar PV systems. In these cases, the C-PACE assessment is paid over a period of time (up to 20 years) and with annual energy cost savings intended to exceed that annual assessment payment.

The City of Boulder's role in promoting C-PACE is one of educating multifamily, commercial and industrial property owners about the various economic and environmental benefits of the program to them and the community, recognizing and promoting those who have used the program to finance improvements, and otherwise supporting broader participation in the program.

The most common barrier regarding C-PACE is the administrative burden of the entire process, which appears to be a large enough obstacle that some Boulder building owners will not consider it until the County's processes are streamlined. Likewise, businesses without strong credit histories reportedly could not secure C-PACE financing. Business owners are also unlikely to take on additional improvements that do not have a much shorter pay-back period than what solar PV installations typically require. However, the City should continue to promote its benefits because of the rooftop solar potential of commercial rooftops in Boulder, the convenience of repayment staying with the property as it changes ownership, and need to encourage "all-of-the-above" financing options to those property owners.

Some form of support from the City is important given the large potential for solar PV on the properties eligible for C-PACE financing -- an estimated 312 MW of capacity at commercial and industrial properties -- and because of the difficulty and cost of transforming the commercial PV market through regulatory measures and financial incentives. Where property owners are considering C-PACE financing to pay for commercial BPO compliance, the City should promote the advantage of adding solar PV equipment as part of their package of improvements.

Becoming familiar with the program and its potential for C-PACE eligible properties can prove beneficial for the City once it becomes a municipal electric utility, as the City would then have experience with the program's capabilities and knowledge of how to incorporate it with other incentives provided to those properties. Furthermore, the purchase and installation of electric vehicle supply equipment (EVSE) for buildings or parking lots is eligible for financing under the C-PACE program. Thus, the C-PACE program can help the City build a strong link between electric vehicle (EV) charging stations and solar PV—a priority deemed extremely important by City officials and voiced to the consulting team. Currently, energy storage technologies are not eligible for C-PACE financing.

ACTION PLAN

2024: Engage stakeholders and list opportunities on one-stop platform

1. Work with the State Energy Office and C-PACE's oversight board, the New Energy Improvement District (NEID), to track the economic and environmental benefits to those that have utilized C-PACE financing for commercial rooftop solar PV.
2. Work with Energy Smart and Partners for a Clean Environment to promote the benefits of C-PACE financing to business owners with high-potential solar spaces
3. Because multi-family properties with five or more units are eligible for C-PACE financing, partner with the State Energy Office and Energy Outreach Colorado to develop a customized outreach effort that targets this hard-to-reach sector
4. Integrate C-PACE programming into one-stop resource center and other information platforms to inform and educate commercial property owners about success occurring among their peer group, with link to the State's and County's C-PACE websites

Strategy Rationale

- C-PACE can be an effective financing option, particularly for commercial business owners with limited capital funds, relatively low credit scores, or short-term leases

Keys to Success

- Identifying C-PACE eligible properties with good solar resources
- Sharing case studies of local C-PACE financed projects

Cost Impacts to the City

- Estimated < $20,000 annually, focused largely on education and outreach
- Incorporate into other education and outreach campaigns where feasible

Major Barriers

- Individual property owner credit-worthiness
- C-PACE applications and processing can be administratively burdensome for some property owners

Phase 2 - Strategy 4:
Community Solar Gardens at City Facilities

Target Impact on New Generation by 2030	2 MW
Technical Challenges	6/10
Administrative Burden to City FTE	1 FTE + $65,000 outsource support for startup
Difficulty to Transfer to Muni Utility	6/10 Planning for transfer to municipal utility by including specific transfer clause in CSG contracting adds to setup cost and complexity but can reduce difficulty at transfer point

The City of Boulder operates numerous facilities with available roof, parking lot, and/or ground space to host more solar capacity than is needed for on-site use. These areas can be developed as Community Solar Gardens to provide generation bill credits to off-site subscribers, whether other City facilities or local residents and businesses.

The City of Boulder maintains a robust municipal infrastructure and recreation management approach, which leads to a relatively high number of City-owned and operated facilities. Several City facilities have been built or retrofitted with on-site solar installations to offset site energy usage, and more facilities could be pursued in this way (see Appendix for review of high-potential City-owned sites), with on-site solar designed to generally match on-site load through a Net Energy Metering (NEM) arrangement with the utility, Xcel Energy (Xcel).

However, many City facilities experience a mismatch between available space for the development of solar installations and the level of energy production needed for on-site usage. For example, sites such as parks, parking lots, and parking garages often use very little or no energy, but have abundant space for solar development. Conversely, multi-story buildings with relatively high energy loads may not have the physical footprint to host the requisite solar capacity needed to offset building energy consumption.

The option that exists for the City's large-footprint/low-usage sites is Xcel's Community Solar Gardens (CSG) program. Under this program, a limited number of projects are allowed to be connected to the utility grid, with all production being exported directly to the grid, and a bill credit being offered by the utility for each kilowatt-hour (kWh) produced. Subscribers to a CSG receive these production credits on their utility bill, which offset the payments the subscribers make, either upfront or ongoing, for the construction of the CSG project.

Without a municipal utility, CSG are the most viable option for the City to develop solar at parking lots, parking garages, and other facilities where available space exceeds on-site electricity

consumption needs. Financial benefits of CSG tend to be marginal, so cost control is necessary to ensure viable projects that support the City budget. By approaching CSG as a portfolio-wide procurement, the City can leverage economies of scale in the procurement of: 1) turn-key programs, 2) turn-key systems with City program management, or 3) subcontractor installation services, depending upon the City's desire for ownership and control of solar assets, measured against staff availability and risk profile.

Pursuing turn-key programs would involve the City leasing potential installation space to solar developers skilled in building projects and managing a CSG subscription program. This strategy would be the easiest to implement, with the key hurdle being the identification and compilation of City sites for presenting to the installer community. The City would be required to expend minimal staff-time for project development, as the proposers would manage all parts of project planning and subscriber on-boarding. The City would need to negotiate a standardized lease contract for all available sites, reducing transaction costs for both the City and the selected developer. With this hands-off approach, the City would have limited or no control over solar system components or subscribers, and would be forced to give up site control for an extended period of time. Revenues would come as lease payments or, if City utility accounts were subscribers, through utility production credits (less any subscription payments to the developer).

Turn-key system development with City program management would be a second approach to developing CSG on City facilities. The City would still identify and compile sites for presentation to the installer community, but the City would manage the subscriber program. The projects could be built as City-owned facilities bought through cash payments (either from internal funds or through dedicated bond or tax proceeds) or the projects could be developer-owned, with the City agreeing to purchase all energy production through a Power Purchase Agreement (PPA). In either case, the City would select subscribers, meaning that the City would have the control to have all benefits accrue to City accounts, or the City could arrange for subscription benefits to accrue to residents of low income, green-minded businesses who win local sustainability competitions, or any other community group for whom the City would like to support or incent clean energy adoption. This strategy would certainly require more staff-time to operate, but would provide additional City control for offsetting City electricity accounts or for implementing affiliated community programs.

The third, and most labor-intensive and capital-intensive, approach would be for the City to use internal or subcontracted staff to design solar systems that best meet the budget and requirements of the City's long-term goals. The City would procure solar components directly from manufacturers, potentially reducing the costs of materials. Installation labor could come either through subcontracting to local installers or potentially from City-operated labor training and placement ("green collar") programs, or some combination of the two options. Subscriber management would again be managed by the City, allowing the possibility of the City arranging to trade system subscriptions for installation labor. This strategy provides the greatest level of City control and management options, but would also require the greatest commitment of City staff and monetary resources and would lead to the most City risk exposure.

Naturally, some hybridized approach to the strategies is also possible, and probably the most likely. For current purposes, this report will assume that the City will prefer to seek turn-key program development with site leases. In this hypothetical scenario, the City's leases with solar developers would include a buy-out option for both the solar project and the CSG subscription program, so

that the City could seek and obtain greater control and flexibility at a future date. This scenario also assumes that the site leases would include subscription set-asides for City facilities (which developers value, since the City is a strong credit-worthy subscriber), but no requirements for carve-outs for other customer types. Again, such a requirement could be worked into lease language, particularly if the City were willing to back-stop any subscribers that project investors would see as potentially risky.

Under a municipalization scenario, the need for the CSG approach would be reduced, since solar assets would be feeding into a grid controlled by the City. Essentially, all City facilities could be developed as CSG systems to become assets in the City's energy generation portfolio. Since Boulder residents would no longer by Xcel customers, they would likely no longer be eligible for Xcel CSG production credits. To prepare for this scenario, the City should plan to implement a similar CSG program to offer to subscribers and developers who may otherwise be left without an energy offtaker if Xcel were out of the picture. As part of that Boulder CSG program, locally-produced solar energy, whether on City facilities or on other community installations, could be sold at a premium to subscribers who choose to support local generation, or could be sold at a lower price to customers with low incomes or other customer types that the City chooses to support or incent.

There are three apparent ownership models for a community solar program in Boulder:

1. A developer leases land (or rooftop) inside city limits and builds a system directly feeding power into the local utility distribution system. The developer or a third party operates the program and subscribers obtain "shares" from the developer or an administrator of the project. Bill credits flow through the regulated CSG bill credit mechanism to the City as a subscriber in the energy output.
2. A developer can own the system and provide the power to the local utility while the City serves as the anchor tenant (and possibly as customer of last resort or financial backstop) who then manages sub-subscribers who would obtain the shares from the City, who, in turn, administers the project energy allocations through the regulated CSG bill credit mechanism. Such an arrangement would enable the City to structure its sub-subscriber allocation to increase access to renewables for targeted customer classes, such as residents with low-to-middle incomes, low-credit renters, non-profit organizations, or environmental activists willing to donate their credits.
3. The City of Boulder could solicit participants to invest in the development of a solar power plant, which would deliver energy under Xcel's CSG program and generate revenues for the investors. The energy produced would be tracked and assigned synthetic community solar attributes. These synthetic energy credits would then be assigned through an ad hoc solar garden program by transferring the synthetic kW-hrs and revenues associated with the delivered energy through a separate bill or as a credit on City utility water bills. It is likely that this would be a premium product (i.e. negative bill credit).

The first two are considered "in front" of the meter and may require a financial incentive from the city to operate. Front of the meter ownership models also result in Xcel retaining RECs. The third model is considered a "behind the meter" model under which the city could retain RECs. Megawatt-scale solar prices in Colorado currently average $1.50 to $3/Watt. Setting up a Community Solar program would require significant staff or consultant time in year 1.

ACTION PLAN

2020-2026: Implementation over a six-year period

1. Immediately identify all City-owned facilities with ability to support more solar capacity than needed to offset on-site energy usage
2. Determine preferred City procurement strategy (further steps assume hybridized turn-key program, with buy-out option, as discussed above)
3. Develop procurement documents and proposed contract terms for issuance to solar developer community
4. Review proposed site lease and buy-out terms and make determination of selected vendor
5. Work with selected vendor to obtain Xcel production credit approval under the CSG program and to pre-apply for interconnection approval
6. Coordinate site due diligence and program outreach with selected vendor

Strategy Rationale:

- Community Solar Gardens enable large solar installations at City facilities that may not be able to use all produced energy on-site

Keys to Success:

- Clear identification of full portfolio of sites available
- Internal determination of preferred procurement/ownership strategy
- Specified contract/lease terms to meet City goals

Cost Impacts to the City (assumes hybridized procurement approach):

- $50-60K in either internal or external feasibility assessment and procurement support
- 8-12 weeks of internal staff time for planning, proposal review, contract negotiation

Major Barriers:

- Willingness to lock up site usage in long-term (~20-year) solar leases
- Utility upgrades for interconnecting solar systems larger than needed for on-site usage
- Understanding trade-offs to REC ownership and sales
- Determination of path forward if municipalization proceeds
- Competitive bid process into Xcel's program

Phase 3 - Strategy 1:
Promote New Tariffs at Muni or State Level

Target Impact on New Generation by 2050	20 MW
Technical Challenges	Muni 3/10; Non-muni 9/10
Administrative Burden to City FTE	1.5 FTE
Difficulty to Transfer to Muni Utility	7/10

A Renewable Facility (RF) rate is an example of a customer-specific electricity rate that allows the full costs of solar to be passed on to the companies that want it without impacting other customer costs. This type of special rate can be constructed in several ways, including as a virtual net energy metering (VNEM) mechanism which offsets one-to-one energy consumption for a single large subscriber. The City can work to create an RF program for engaging commercial partners such as Google and other large energy-users to incentivize new PV development through rate incentives.

A new Renewable Facilities rate was first negotiated in Virginia in October 2017 between Dominion Energy and Facebook.[24] Reports indicate that the Dominion RF may add about 300 MW in new solar generation and attract $750 million in new data center investment.

Should Boulder remain an Xcel customer, extensive coordination would be needed between commercial partners and the utility to create new rate structures. As a municipal utility, implementation of this strategy would be much more straightforward, as Boulder would have the option to promote RF rates immediately.

A second, related, option would be to design (under the municipalization scenario) or advocate for (under the current Xcel scenario) a feed-in tariff (FIT) or eligible renewable generation (ERG) tariff. These types of rate structures would define a value for energy produced from (ideally, local) solar installations and exported to the utility grid, with the value being set for a extended period of time to enable long-term planning for developers and investors, and well as for the utility, whether Xcel or City-owned. Both a FIT and ERG would mesh well with the recommendation for rooftop solar lease, as these types of programs provide another energy offtaker option to help solve the split-incentive issue. The important effect of both strategies is that they provide market confidence signals. The market requires confidence from both parties: Large rooftop PV developers require the confidence that they can deliver export energy at a fixed-price contract for at least 10 years; commercial rooftop owners require the confidence that they can lease out roof space at a fixed rate to developers with certain guarantees and protections for a fixed term of 10 years or longer.

[24] *http://www.elp.com/articles/2017/10/promise-of-dominion-solar-brings-facebook-center-to-virginia.html*

ACTION PLAN

2030-2040

1. Assemble an internal City team to explore the feasibility of a new RF, FIT, and/or ERG rate
2. Coordinate details of the concept with the Rates Working Group of the City's Solar Working Group
3. Approach both Colorado PUC and the Colorado Governor and legislature leadership to gather support for PUC proceedings to create the proposed rate structure or structures in Colorado
4. Contact Virginia PUC, Dominion Power and Facebook, and other commercial officials and discover how the RF rate was designed and intended to be implemented
5. Establish a reasonable timeline and milestones for creating a similar rate or rates in Colorado
6. Meet with Google, IBM and other large commercial customers to discuss the possibility of using an RF rate
7. Enlist the support of all major stakeholders that can lobby for this initiative alongside Boulder at the state level
8. Establish and implement a formal implementation plan for the RF rate with others

Strategy Rationale

- The RF rate is an equitable (customer-neutral) way to match significant solar PV capacity to large existing loads

Keys to Success

- Governor and PUC support
- State level leadership of large Boulder C&I customers interested in the RF rate
- Ensuring that the rate is truly neutral to other customers

Cost Impacts to the City

- Short term costs primarily are for staff time
- Approximately 0.5 FTE would be needed for this work at the state level

Major Barriers

- Negotiating a new rate at the state level can be time consuming and complex
- Cost neutrality will be important at the PUC

Phase 3 - Strategy 2:
PV + Bulk Energy Storage

Target Impact on New Generation by 2050	10 MW
Technical Challenges	9/10
Administrative Burden to City	0.75 FTE + Outsourced Support FTE
Difficulty to Transfer to Muni Utility	6/10 However, provides essential resource to muni utility, and may be viable using existing water plants for pumped-hydroelectric storage

The Phase 3 implementation of this strategy will unquestionably face infrastructure limitations based on daytime over-generation from local solar built in Phases 1 and 2. Energy storage provides Boulder with the ability to continue to expand the solar market by addressing the intermittent nature of solar energy. The relative value of a dispatchable-generation asset compared to an intermittent-generation asset can be apparent in the levelized avoided cost of energy (LACE), which models new capacity of intermittent solar energy as 14% more expensive than dispatchable energy[25]. In western states, utility-scale solar is often curtailed even at present penetrations; without dispatchability, new solar will most likely face a significant bottleneck in grid-hosting capacity and market worth. The City is fortunate to have a hydropower system that may serve as a reversible pumped hydroelectric bulk storage.

Should Boulder retain energy supply from Xcel energy, options exist for the city to take advantage of developing rate incentives and Time-of-Use (TOU) pilots to maximize the value of local renewable energy through solar plus storage projects. Should Boulder succeed in municipalization, a combination of rate pilots, incentives and direct install programming becomes possible and has the potential to accelerate local market uptake of storage and PV technology, moving the city towards improved resilience, resource adequacy, and local renewable generation goals.

Solar energy is intermittent and variable in nature. Time of day, weather, and technology features all contribute to the variability of renewable energy generation. As a result, problems with energy supply, capacity, and demand can arise that affect the underlying economics and value of PV resources. Several of these challenges can be addressed through the integration of energy storage alongside PV assets. Rolling out energy storage will equip Boulder with the ability to capture the full value of PV energy by spreading its use throughout the day, as well as create standalone storage value such as emergency back-up, frequency regulation and new revenue streams and cost savings from either energy arbitrage or peak-demand shaving. It is estimated that power outages, surges and spikes cost the U.S. economy more than $150 billion every year, and energy storage is key to

[25] *https://www.eia.gov/renewable/workshop/gencosts/pdf/lace-lcoe_070213.pdf*

Boulder building a disruption-proof grid by providing on-demand capacity and responsive balancing capability. [26]

In addition to benefitting from any allowable energy rate arbitrage (charging during inexpensive rates and discharging to the grid during more expensive rates), energy storage can allow the City faster response times during emergencies and the ability to feed power quickly to where it is needed.[27]

Options for promoting the development of local solar and storage projects exist either as an Xcel Energy customer or under municipalization. However, it is our view that municipalization offers more opportunities for flexibility and scale by placing programs, financing, and procurement of energy resources under direct City control.

Colorado is currently in the process of developing its protocol for integrating Energy Storage Systems (ESS) into the programs, rate cases, and billing system of regional utility Xcel Energy. Xcel recently navigated a multi-stakeholder process to develop the policy framework for Colorado's clean energy transition and create the needed data, infrastructure, and rate structures needed to begin incentivizing and growing Colorado's energy storage market. A summary settlement agreement concluded in August 2017 resulted in the following outcomes that pertain to energy storage in Boulder:

1. A TOU Pilot is currently being implemented to test net metering rates: 225 MW of rooftop, 117 MW of community solar gardens and 60 MW of industrial waste heat generation is approved. The Pilot concludes in 2020 and will inform Colorado's residential and TOU rate structure.
2. 18,000 volunteers will get advanced meters as part of the Pilot by 2020

The inclusion of TOU Pilots in Net Metering studies, as well as testing of advanced metering, stands as an indicator of things to come for Colorado. It can be expected that smart controls accompanied with DER will play a major part in Colorado's energy future starting in 2020. By getting ahead of the policies and developing local action plans that consider the shifting regulatory landscape, Boulder can prepare the development of local renewable plus storage models in a way that links with regional energy planning.

Specifically, should the City of Boulder choose not to municipalize its energy procurement and remain a customer of Xcel Energy, it should work to enroll all new solar plus storage projects on municipal sites in TOU rate pilots. Doing so will allow the city to capture a wider range of revenue from shaping their energy demand footprint by using energy storage systems, as well as allow for Boulder to begin to identify opportunities to capture revenue from Net Energy Metering and solar energy sales while simultaneously providing rate structure input during a pilot program to move Xcel towards value of renewable or NEM 3.0 pricing for solar. TOU pricing has the ability to allow Boulder to bank PV generation in their battery systems and sell it to Xcel for the highest value based on wholesale market price fluctuation during ramping or peak energy use periods.

[26] *https://energy.gov/sites/prod/files/2013/08/f2/Grid%20Resiliency%20Report_FINAL.pdf*

[27] *Utility Dive, Energy Storage Could Hit 35 GW by 2025, New White Paper says, November 7, 2017, https://www.utilitydive.com/news/energy-storage-could-hit-35-gw-by-2025-new-white-paper-says/510188/*

In addition to providing opportunities to lower electric bills, municipal facilities equipped with energy storage systems could boost Boulder's resilient capacity in the event of unforeseen power loss or other adverse event. Community centers, hospitals, libraries, and public safety services all offer valuable emergency services during extreme weather events such as snowstorms or heat waves. Equipping these essential service-providers with energy storage can enhance Boulder's ability to conduct emergency response and provide community services, and this complements the City's existing energy assurance work funded through the U.S. DOE.

When Boulder starts to operate a municipal electric utility, the opportunities for, and benefits of, energy storage are multiplied:

- Creation of storage programs for all sectors, including municipal facilities, commercial, industrial and residential, whereas under Xcel, only municipal facilities are likely to be addressed in years one through five
- Power Purchase Agreements of local renewable energy from solar plus storage projects in year one of municipalization
- On-bill financing programs for all sectors and customer groups within five years of municipalization
- Direct-install programs targeted at residents of low and moderate income (LMI) levels or any other customer segment in year one or two of municipalization
- Virtual Power Plant (VPP) and aggregation procurements in year six of municipalization, allowing for Boulder to gain direct ownership of a network of distributed energy assets needed to meet local resource needs and maintain competitive rates.

ACTION PLAN AS AN XCEL CUSTOMER

1. Define storage targets and percent of peak energy demand to place under storage contract by 2030 in year one
2. Continue working with Xcel Energy and identify opportunities for participation in TOU pilots for energy storage projects
3. Identify opportunities for enrolling in Xcel advanced metering programs

ACTION PLAN UNDER MUNICIPALIZATION:

1. Define storage targets and percent of peak energy demand to place under storage contract by 2030 in year one after municipalization
2. Develop credit enhancement strategy designed to fund procurement of energy storage assets in year one of municipalization and collaborate with other public-sector agencies to explore joint development opportunities
3. Implement NEM 2.0 rules for year one of municipalization, and move towards TOU rate pilots for C&I sector in year two to three; expand to residential market in year four
4. Implement rolling requests for proposals for PPAs designed to provide local resource adequacy in year one and link storage technology with new solar development
5. Provide direct-install or on-bill financing program beginning with LMI residents in year two or three of municipalization

Strategy Rationale:

- Energy storage addresses the intermittent nature of solar and opens up new revenue streams while providing local resilient capacity and energy arbitrage opportunities (as allowed by State laws)

Keys to Success:

- Engagement with Xcel to capture TOU pilot enrollment and inform economics
- Clear definition of storage goals and cost tradeoffs between resilience, revenue, and emission reductions
- Active and engaged C&I sector willing to participate in an emerging storage market

Cost Impacts to the City:

- Moderate to Large and dependent upon capital purchase needs
- Administratively burdensome with requirements for external expert support
- Opportunity for cost savings if deployed for municipal assets to reduce energy bills
- Costs are deferrable through Pay for Performance and at-risk contracting strategies

Major Barriers:

- Siting and identifying facilities ready for storage
- Currently reliant on Xcel to define process and rules around energy storage rates and interconnection
- Time and budget needed to identify sites and model appropriate battery technology
- Navigating and designing public process, billing support, and rate structures

Phase 3 - Strategy 3:
PV + On-site Energy Storage (Pilot at City Facilities)

Target Impact on New Generation by 2050	3 MW
Technical Challenges	8/10
Administrative Burden to City FTE	.25 FTE + $50,000 outsourced support
Difficulty to Transfer to Muni Utility	5/10
	Will likely require ancillary services tariff planning, and dispatchability oversight

Under this model of energy storage procurement, the City will design an RFP that outlines specific energy storage project outcomes (e.g., critical facilities backup power, reduction in diesel stationary power, resilient community facilities) and pursues them through partnership with energy service providers and outside contractors who would operate energy storage for grid management purposes the majority of the time, but would share the utility savings that they create for the facility by peak shaving and load shifting. Rather than pay for energy storage infrastructure in advance, pay-for-performance contracting offers a means through which the City can source pilot energy storage program and project ideas with a minimum up-front cost. Thus, the City loses a percent of energy savings revenue through its shared savings financing obligation, but does not bear the full cost of the storage capacity which is often otherwise idle.

Implementation requires that the City design a standard energy storage contract that outlines specific desired resiliency outcomes, combined savings including PV, and energy storage capacity.

While the specific capacity of new generation capacity that can be created through a series of rolling energy storage procurement periods is hard to quantify, the program serves to stimulate pilot projects that innovate to solve PV grid congestion impacts leveraging municipally-held assets that benefit form critical power backup.

The program can then be scaled to serve residential, industrial, and commercial customers. After completion of the pilot stage the City can use their own rolling procurement processes to identify service providers and create savings for the larger community through either an on-bill financing or utility-owned assets (under municipal electric utility scenario).

Under the continuing Xcel energy scenario, the City can offer to facilitate procurement, measurement and verification (M&V) or billing support on behalf of commercial or industrial property owners. Doing so will maintain a high standard for implemented work from third-party service providers and allow the City to track its progress towards planning goals.

Whether for municipal or commercial facilities, on-site energy storage contracting should be accompanied by a post-project measurement and verification process designed to verify that

increased PV grid compatibility, energy savings, sales, other revenues, and project costs have been achieved prior to any payments issued.

To work efficiently, Boulder may need to make energy use records for assets targeted during a rolling procurement term available through a web-platform to generate high quality bids based on real data and savings or revenue generation. As such, a Pay-for-performance approach for commercial muni customers works best alongside a one-stop solar/storage online platform.

ACTION PLAN

2031-2033: Building Codes

1. Develop municipal building and safety codes for combined PV + energy storage and standalone energy storage

2034-2037: Define desired outcomes and plan targeted City facilities pilot

2. Develop stakeholder engagement, timeline planning for procurement, and evaluation criteria
3. Review energy storage contracting conditions; they should be clearly defined for PV compatibility, grid benefits, and energy savings with the support of the City's engineers and legal team prior to procurement
4. Define preferred payment terms and cost recovery mechanism: payment should be after M&V on a periodic basis (in municipalization scenario this may appear as an on-bill payment for private facilities that participate in follow-on rounds after City facilities pilot)
5. Develop procurement ranking and proposal evaluation criteria
6. Solicit bids and select winners

2037-2040: Validate and measure results from pilot

1. Review performing projects and redesign payment requirements and periods for community launch
7. Publicly release PV enabling energy storage pilot records, business case sample interval data, coordinate public launch and events with one-stop solar platform
8. Engage with stakeholders to build in feedback
9. Solicit qualified installers
10. Replicate process in future periods and continue to review increases in PV compatibility from on-site energy storage against bulk energy storage

Strategy Rationale

- On-site energy storage may provide facilities cost savings and resilience benefits which bulk energy storage cannot provide
- City facilities can be used as a pilot for pay-for-performance combined PV + energy storage procurement to lower upfront capital needs and facilitate new solar generation without increasing negative grid impacts

Keys to Success

- Well defined facility and grid benefits objectives
- Clear performance contract and legal terms of payment
- Clear and specific procurement terms and robust selection process
- Strong data management practices and M&V

Cost Impacts to the City

- Low to none after initial procurement round
- Outside consultants may be needed for first phase of implementation

Major Barriers

- Gaining access to grid management datasets needed to attract bids and prove savings
- Finding facilities prepared for shovel-ready projects
- Working with the utility to design grid benefit objectives and cost recovery (continuing Xcel scenario)
- Longer payback periods
- Defining legal terms and contracting requirements
- Managing RFP procurement process