EAST BAY community energy

The Power to Choose

Notes regarding submitting comments on this Draft Work Product:

Comments are Due February 7, 2018.

Comments shall be no longer than 5 pages.

Comments should be submitted to LDBPcomments@ebce.org

Energy Storage Contracting Strategy

for

East Bay Community Energy

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January 2018

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Introduction

The clock is already ticking for East Bay Community Energy (EBCE) to meet an energy storage mandate requiring that 1% of peak load be under contract for energy storage by 2020, with the construction of those projects to be completed by 2023.[1] For EBCE, which is expected to be the largest CCA in the state at full enrollment, this represents a sizable requirement. Based on EBCE's Implementation Plan the agency's peak load at full enrollment is expected to be 1,416 MW, and that means that the overall local capacity requirement (50% of peak) will be 708 MW and the energy storage capacity requirement (1% of peak) will be ~14 MW.

This presents a new challenge for emerging CCA's like EBCE, as the time window for compliance also comes during a period when EBCE will not have an established credit rating that allows them to directly fund the purchase the energy storage capacity. However, by working collaboratively with EBCE member jurisdictions, local agencies and organizations, and other community partners through a combination of credit enhancement and financing partnerships, EBCE could directly support the deployment of utility-scale energy storage locally that meets the organization's storage mandate. EBCE can also accelerate the deployment of behind-the-meter energy storage systems for customers through various approaches to providing incentives, attractive financing options, and/or special rate structures. EBCE could leverage available State funding (i.e., California Energy Commission grant funding) and/or public private partnerships to fund pilot demonstrations of energy storage applications at various scales and use cases.

Building local energy storage capacity does more than simply support compliance, it lays the foundation for advancing long-term local energy autonomy and resource adequacy goals, as well as enhances long-term economic stability and reliability for EBCE overall. If implemented with the long-term goals in mind, the value chain of energy storage capacity can insulate EBCE from wholesale procurement risk, provide a critical tool for maintaining competitive rates, allow the organization to manage the duck curve, and offer local resilience and cost-savings for a wide range of EBCE customers, including businesses, residents, and even low-income and/or disadvantaged community members.

The energy storage contracting strategies outlined in this section are designed to help EBCE meet or exceed state mandated energy storage requirements, and build towards the development of an operational virtual power plant (VPP) that aggregates distributed energy resources (including energy storage) into a valuable dispatchable asset within a 5-7 year timeline. A VPP strategy can enable EBCE to aggregate and fully leverage the benefits of a smart, clean, distributed, and dispatchable energy network. This approach would allow EBCE to respond to ever changing market conditions in real-time by allowing the organization to

[1] AB2514-Skinner and CPUC R.10-12-007, http://www.cpuc.ca.gov/General.aspx?id=3462

dispatch energy storage (and other DER's) to manage peak demand, smooth and shift the supply of intermittent renewable energy (i.e., solar PV) to peak load hours, and meet local capacity requirements cost-effectively. The benefits of this approach to EBCE include: lowering overall operating costs, reducing portfolio emissions and environmental impacts, minimizing and mitigating risk exposure, maximizing revenue and allowing EBCE to maintain low, competitive retail rates for its customers. Such an approach would also support the transition to a truly transactive energy market that leverages sophisticated rate and tariff structures, real-time pricing, energy arbitrage, and an engaged community of ratepayers and DER owners to contribute to EBCE's ability to offer low and stable rates

The EBCE LDBP Energy Storage Contracting Strategy is broken into the following sections.

1. Capital Financing and Credit Worthiness
2. Residential market programs
3. Commercial and Industrial Market Programs
4. Virtual Power Plant Aggregation

Summary of Key Recommendations

1. Implement a residential market CARE customer small scale storage giveaway program
2. Implement residential NEM/TOU Rate Pilots
3. Implement commercial NEM/TOU Rate Pilots
4. Deploy collaborative procurement efforts to obtain credit enhancement required to build storage capacity
5. Aggregate distributed storage resources in year 5+ to form a Virtual Power Plant

I. Capital Financing and Credit Worthiness

As new agencies, California's Community Choice Aggregators do not launch with established credit histories and must work to build solid balance sheets and impeccable credit ratings during their initial years of operation. While strong revenue from ratepayer dollars is expected once EBCE begins operations, the initial lack of an established credit rating can hinder the organization's ability to access funding for significant capital investments such as energy storage systems. In order to access capital and secure favorable terms that can make such investments cost-effective, CCA's must demonstrate stable and consistent revenue streams, positive cash flows, low and stable customer opt-out rates, and a strong organizational capacity to manage risks and build substantial operating reserves.

The success of the existing CCA's in California has demonstrated that the business model of community choice is more than capable of establishing investment grade credit ratings. The most recent CCA's to launch in California have not had significant challenges securing the startup capital and lines of credit they needed to setup the program and procure the power products required to serve their load. It may be possible for some CCA's to leverage these limited lines of credit to meet their energy storage mandate through their Resource Adequacy procurement process for local capacity requirements. This would depend on a number of factors, including the CCA's peak load (i.e., size of 1% energy storage requirement) and the ability of their wholesale energy service providers to contract with an adequate supply of compliant storage capacity.

However, the lack of an established credit rating is also a limiting factor, because it inhibits the CCA's ability to simply conduct a procurement process (i.e., RFO, RFP, etc.) to contract directly with energy storage developers to deploy new energy storage systems. Without a credit rating, lenders will almost certainly require some sort of a bankable claw back mechanism through which to reclaim their capital should opt-outs or other financial or operational risk manifest that prevents the realization of project implementation and future cash flows.

Pragmatic and cost-effective solutions to this issue do exist, which can allow EBCE to meet or exceed its energy storage procurement target and further support its goal of supporting rapid deployment of clean energy assets within its service territory.

Credit Enhancement

The first option is to work with organizations within the EBCE service area to secure a credit enhancement or "credit sleeve". According to Standard & Poors:

> "Credit enhancement (or credit support) is a risk-reduction technique that provides protection, in the form of financial support, to cover losses under stressed scenarios. Think of credit enhancement as a kind of financial cushion that allows securities backed by a pool of collateral (such as mortgages or credit card receivables) to absorb losses from defaults on the underlying loans. Thus, it's not the case that through securitization, poor credit assets somehow "transform" into solid investments; instead, credit enhancement helps to offset potential losses. Credit enhancement is used in project financings, public-private partnership transactions, and structured finance to help mitigate risk for the investors, and has been an accepted practice in bond financing for more than two decades."[2]

Under a credit enhancement arrangement, a partner agency would extend their credit to EBCE offering collateral, insurance, or a third party guarantee of payment. Potential community partners that could provide credit enhancement arrangements to support finance the deployment of energy storage systems (and other DERs) may include:

- EBCE's member jurisdictions
- Alameda Municipal Power
- The Port of Oakland

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[2] Standard & Poors. June, 2008. The Basics of Credit Enhancement in Securitizations. Retrieved from: https://fcic-static.law.stanford.edu/cdn_media/fcic-docs/2008-06-24%20S&P%20Basics%20of%20Credit%20Enhancement%20in%20Securitizations.pdf

- East Bay Municipal Utility District
- Universities/school systems
- Commercial property owners

According to the Office of Energy Efficiency and Renewable Energy, credit enhancements can take on many forms including:

1. Loan Loss Reserves (LLR): Which set aside a reserve pool to cover potential loss or repayment risk.
2. Loan Guarantee: which covers the entire amount of capital provider's potential losses on a portfolio of loans. However, State Energy Program or Energy Efficiency and Conservation block Grant funds are not eligible as loan guarantees.
3. Loan Loss Insurance: which is a private product that lenders can purchase or a grantee can purchase on behalf of a lender. Where in exchange for a premium a private insurer covers the risk of losses.
4. Debt Service Reserves: which sets aside a fund to cover delayed or defaulted payments on a debt instrument (loan). For instance, a bond might require setting aside a 6-month debt service reserve, or perhaps 10% of the total amount of the bond to cover potential defaults.
5. A Subordinated/Senior Capital Structure: which allows two types of capital to be placed into a loan. The first one, subordinated capital absorbs the potential first losses on a loan and might be set at 10% of the total loan amount. Senior capital does not absorb any losses until the subordinated capital is exhausted. This structure acts in some ways like an LLR and serves to attract the senior capital because the subordinated capital takes on the majority of the risk."[3]

While any of the above credit enhancements can be utilized to improve EBCE's credit worthiness, lower interest rates, or absorb risk and loss, Loan Loss Reserves (LLR) and Subordinated/Senior Capital structure may be the easiest to obtain in the near term.

Loan Loss Reserves

LLRs are attractive as the contingent pool established by reserves can act as the collateral needed for an investor to allocate funding. A contingent pool sometimes called a 'lockbox" can be funded by either on bill surcharges or from existing revenue streams such as ratepayer dollars. The addition of a new line item on the bills of customers participating in DER programs could act to fund the LLR pool across a diverse range of projects, effectively rolling default risk towards the portfolio level, rather than holding risk on a project by project basis. At a certain point, it may be beneficial to allow a LLR fund to be withdrawn from after a capped level of funding is reached, essentially "water falling" financing into new projects or creating a new source of capital for funding EBCE activities. A waterfall mechanism could be used to fund a

[3] Office of Energy Efficiency and Renewable Energy: https://energy.gov/eere/slsc/credit-enhancements

revolving fund for future project investment. In addition, EBCE may want to consider breaking DER projects into tranches based on revenue and cashflow to carry risk at different ratings, as doing will allow for EBCE to securitize assets by risk profiles and attract institutional investors or commercial banks to invest in a portfolio of assets rather than on a per-project basis through the mechanism of collateralized debt obligation (CDO).

Subordinated/Senior Capital Structures

Subordinated/Senior Capital Structures also would make funding DER projects more palatable to external investors by bringing a second balance sheet into the investment package. Under this method of credit enhancement EBCE would split the risk of project default with a partner agency such as a municipality, university, or commercial property owner and define in their debt service contracts who is responsible for what portion of the risk involved in project financing. This strategy would first be deployed in collaboration with mission aligned organizations with strong balance sheets who are willing to help underwrite a loan to create the value chain and future cashflows possible from developing storage on their property.

It is notable that under a subordinated/senior capital structure EBCE would be likely to not own the asset in early years when they need a third party to carry more risk than them. As a result, any stored energy (or related services) could be procured through a power purchase agreement (PPA). However, PPAs can be paired with buy-out clauses that allow for EBCE to assume ownership of the asset once a credit rating is established and low-cost capital becomes more easily accessible in years 6+ of operation.

Renewable Energy and Energy Storage Bonds

Alternatively, EBCE could consider partnering with the municipalities within their service area to issue a renewable energy bond designed to spread future revenue from project development over a 10 or 20 year time period. Muni bonds have long been used by cities and counties to generate the capital needed for infrastructure investment by creating a financial product for investors that are longer term and relatively low risk. Entering bond contracts would also allow for EBCE to gain credit enhancement based on the Muni Bond Ratings of the cities within its service area, lowering default risk and improving the likelihood of capital funding while lowering interest rates.

EBCE should still be aware of the risks associated with bonded capital instruments including the impacts of macroeconomics in the form of changes to the Federal Fund interest rate, energy cost volatility, or technological obsolescence. As each can impact future cash flows.

Risk 1: Bond Market Risk, Fed Fund interest rate

Changes in the federal fund rate have positive and negative effects on the US and global bond markets. High interest rates result in lowered investment volume. So if the Fed chooses to raise the interest rates municipal bonds become less attractive as a whole as bonds and interest rates have an inverse relationship, so when interest rates rise bond values go down. The longer it takes for the bond to mature the more susceptible it is to interest rates fluctuations. However, a massive push to develop infrastructure in the United States has the potential to spur a nationwide bond investment in capital upgrade projects. EBCE can harness the desire to move capital into infrastructure investments by using energy storage projects as a bond product offering, creating jobs and local economic investment in the process.

Risk 2: Energy Cost Volatility

Given that under a renewable energy bond future value is based on a combination of energy sales and cost savings, earnings are directly linked to the cost of energy. As such, lower energy costs will result in a bond with a slower payback period, while higher energy costs result in faster pay back periods. Large changes in the anticipated energy rate forecasts used to model cost savings can create payback period uncertainty. Fortunately, energy storage in part provides EBCE the ability to insulate themselves from market price volatility by using Net Energy Metering as an advantage over PG&E's wholesale market price during on peak hours. In other words, energy storage creates the potential to use cheap solar energy during peak hours, keeping rates low in the EBCE service area when the rest of the grid is facing high costs and ramping charges.

Risk 3: Technology Obsolescence

Energy storage technology is developing quickly, each iteration of new products provide improved value additions for consumers including increased revenue from energy arbitrage as well as wholesale energy procurement saving opportunities. There is an opportunity cost associated with owning energy storage available today as rapid technology advance could result in the potential for new savings or revenue streams. For any organization, technological innovation is a reason to hold off on purchase decisions. For example, energy storage installed in 2017 may provide 30% cost savings on energy procurement; but storage installed in 2019 may provide 50% energy and maintenance savings. For a two-year wait, the 20% improvement in cost savings has a cost benefit high enough to justify missing out on two years of cost savings. It is for this reason that a lack of credit worthiness may be a blessing for EBCE, as it forces them into power purchase agreements and leasing contracts that will allow for flexibility as the market and value of energy storage equipment improves. Once the market becomes more established the risk of technologic obsolescence will diminish, making purchase decisions more certain in the face of product and service innovation.

Key Financing and Credit Worthiness Recommendations

1. Create a loan loss reserve funded Subordinated/Senior Capital Structures to gain credit enhancement in years 1-5
2. Conduct targeted outreach to potential community partners with EBCE mission alignment and established credit ratings, and offer procurement management support in exchange for credit enhancement partnership in year 1-2
3. Include ownership buyout clause in power purchase agreements and assume ownership of assets in year 6+ once credit worthiness is more established
4. From year 6+ pursue direct debt services to own and operate energy storage equipment

II. Residential Market Programs

The residential market presents an opportunity for EBCE to engage homeowners and target populations groups to participate in the creation of photo voltaic (PV) and energy storage capacity. Rooftop solar plus storage programs can ease the burden of energy bills and in some cases provide extra income to residents, while also providing EBCE with local carbon free power that helps meet resource adequacy and energy storage mandates and decarbonization goals.

CARE Customer Small Scale Storage Giveaways

Low income community members are often disproportionality burdened by electric bills which consume a larger percentage of their total income when compared to middle and upper income customers. As a result, it is recommended that EBCE offer small scale residential storage systems that enable automatic participation in TOU shaping and load reduction to qualified CARE customers at no-cost. This will benefit EBCE by reducing the peak load during the evening ramp hours, which will reduce procurement costs associated with the high market pricing for energy at those periods, while simultaneously creating benefits and financially equitable outcomes for at risk community members. The cost of energy storage devices applicable in this setting is relatively low as compared to the cost of providing something of equal value to a commercial or industrial customer, providing an opportunity to provide higher value and impact at a lower cost. Implementation of this compelling program could be supported by non-profit community partners and grant funding from state or federal grants. Serving low income community members is also a stated priority for EBCE in its JPA Agreement, which further underscores the value and importance of a program like this.

In the near term (i.e., from Years 1-4) an offer can take place in the form of a the installation of a small storage device at no-cost. We recommend that EBCE do targeted outreach to CARE customers in congested grid areas (i.e., as identified in the LDBP Integrated Capacity Analysis) to promote the program and maximize impact, and that EBCE facilitate the process of acquiring any available state or federal incentives that are applicable at that time.

Applicable technology is available that allows for ease-of-use and simple plug and play installation, which includes easy to use app's for monitoring and control of the energy storage unit with the following target capacity (5 amps) X (4 hours) X (110V AC) = 2.2 kWh. The initial target system cost is $2,000 (1/2 up front, and 1/2 as a function of savings over time) with zero-cost Installation. In addition to these product attributes, the following list features and benefits provides the CARE customer a state-of-the-art energy saving and backup product:

a. Plug and play eliminates the cost of labor for installation.
b. Small scale energy storage for TOU savings.
c. Using the IOU smart meter connectivity to "see" the load and predict behavior.
d. Machine learning to guess what the customer is doing, with a feedback loop.
e. Messaging to the utility account point of contact with hopes of influencing behavioral changes in energy consumption.

f. Wireless or simcard communication to the inverter or chipset for control.
g. Low cost of entry, accessible for low income.
h. SGIP rebate to subsidize.
i. Remote, central control over multiple systems.
j. Permit elimination
k. No inspections

On-Bill Financing

Any future on-bill financing (OBF) or on-bill repayment (OBR) programs offered by EBCE could be used to support the deployment of energy storage to both the residential or commercial market. It is notable that the OBF option requires that EBCE cover the upfront cost of capital purchase, which is recouped through small payments on participating customers' bills. As a result, OBF may not be feasible until later years of operation once credit worthiness is established. The OBR option on the other hand, leverages alternative forms of private capital such as commercial bank backing, specialized lenders, or private sector debt finance through pay-for performance contracting could supply the capital at a sufficiently low rate of interest, and reduce any risk exposure for EBCE.

We recommend that EBCE implement an On-bill Financing program as a long term energy storage contracting strategy for deployment after 2023, when a credit rating has been established and low-cost capital should be readily accessible to EBCE.

Residential NEM and TOU Rate Pilots

The market adoption rate of energy storage in the residential market is largely driven by the underlying unit economics of energy storage and its ability to offset energy procurement costs during peaking hours of wholesale market pricing. As a result, rate structures are a key variable underlying the economics of a sites ability to generate savings or profit from behind the meter energy storage. In the residential market pilot rate programs designed to price the value of Solar + Storage in a way that includes value of renewable pricing such as community benefit, emission reduction, and ability to offset high grid ramping costs may provide an attractive incentive to homeowners looking to retain more financial value from PV and storage systems.

A rate incentive can be advantageous over a direct incentive as it promotes market participation with less risk and upfront capital requirement than direct install programs. A strategy that leaves room for EBCE to design rates in a way that create value for customers and lowers EBCE's portfolio procurement risks and costs, can create a competitive advantage over PG&E and help EBCE maintain low retail rates and low opt-out ratios. Rate design as an incentive mechanism is evaluated in more detail in another section of the LDBP

Net Energy Metering (NEM) rate programs may provide EBCE with the flexibility needed to procure local power at a relatively low cost. It is our recommendation that EBCE applies the Community Benefit Adder (CBA) mechanism promoted throughout the LDBP (including the Dispatchability Adder to incentivize energy storage integration with NEM solar projects), and that EBCE continues to work over time to further develop NEM pricing that builds in the value of renewable pricing concept that compensates for elements like time of use benefits, locational grid benefits, social cost of carbon, deferred transmission investment costs, or the social value of local renewable power. This process should begin immediately to bring residential storage capacity under contract by 2020. Doing so will create a model of rate structuring that can be used an example for other California utilities and set a precedent for a more data driven, local, and transactive clean energy economy.

Rate pilots can also act to drive the sale of energy storage equipment to current solar owners. Existing NEM customers that are enrolled in EBCE provide a perfect opportunity for promoting programs that incentivize energy storage, and tying those incentives to participation in a TOU rate that is beneficial to EBCE is recommended. Acting to promote storage to customers who already have solar assets but are looking to capture more value for their energy by being able to store the energy for use during on peak time periods can help accelerate the market adoption of storage technology by creating a financial incentive for expanding their current asset ownership to include storage technology. This sort of energy storage retrofit installation is also eligible for a 30% Investment Tax Credit (ITC) through 2019.

Strategy	Potential Impact (MW Under Capacity by 2023)	Long Term Impact (2023+)	Capital Costs	Staffing Requirements
CARE Customer Giveaways	1MW	1	Low	NT: 0 LT: 0 Insourced or non-profit partner w/ grant
On-Bill Financing	0MW	5+	None	NT: 0 LT: 1 Outsourced support in near term. Insourced in long term
Residential NEM and TOU Rate Pilots	5MW	5+	None	NT: 1 LT: 1 Outsourced support as well
TOTAL:	6MW	11MW	-	-
NT: 2018 to 2023, LT: After 2023				

Table 1: Residential Market Strategy Impacts and Implementation Requirements

Key Residential Market Recommendations:

1) Work with an outsourced residential PACE partner in years 1-3, bring in-house in years 4+
2) Offer dispatchability incentive on top of ITC and SGIP to CARE customers in year 1, 2
3) Test new rate pilots for TOU and move beyond standard approaches to net metering in years 3-4 to incentivize existing DER owners to participate in the local energy market and expand their ownership of storage assets

III. Commercial and Industrial Market Programs

A combination rate incentives through NEM and TOU pilots, collaborative procurement efforts, promotion of existing financing programs like CPACE, and at-risk contracts can be used to engage the commercial market in energy storage programs.

Commercial and Industrial NEM/TOU Rate Pilots:

Similar to the residential strategy the Commercial and Industrial (C&I) sector can be incentivized to provide new storage capacity through the use of rate incentives. TOU and NEM evolutions that provide more value to local and renewable energy production can help promote the financial success of solar and storage systems.

While rate incentives will inspire more storage capacity uptake by improving the unit economics and financial performance for commercial and industrial customers the mechanism does not provide as many ancillary non-energy benefits such as backup power, emergency response, or any other service that requires direct battery ownership and state of charge control. Any systems throttling to offset high market procurement costs during peak hours will be dependent upon the ability for EBCE to provide price signals to customers that incentivize storage discharge when the energy is needed most. We recommend that any incentives offered to offset direct purchase costs, which differ from rate incentives, should include language that allows for EBCE to have first priority over at least a portion of the state of charge through virtual power plant or automatic demand response applications. We see this as an emerging best practice demonstrated by CCA's like Sonoma Clean Power with their grid-enabled electric vehicle charging station giveaway program, which required participation in a future demand response program as a condition for receiving the free chargers. This feature would be especially critical in the event of emergency or disruption of service event that causes a blackout.

We recommend that EBCE use C&I rate incentives immediately to bring new storage opportunities under contract by 2023.

Commercial PACE

During the first years of operation EBCE will still be working to establish a credit rating, making the use of debt to purchase battery capacity in large quantities unlikely. However, EBCE can still use education and outreach tools to build partnerships between C&I customers and private sector Commercial PACE (CPACE) providers.

> "Property assessed clean energy, or PACE, is an innovative way to finance energy efficiency, renewable energy, and water upgrades for residential and commercial builds. Property owners can finance up to 100% of their project for up to 30 years as a tax assessment on their property bill. The assessment obligation may be assumed by the new owner upon property sale and – under most leases – can be shared with tenants."[4]

Other CCAs like MCE Clean Energy are currently using PACE to promote energy efficiency gains in their service area. However, all energy efficiency programs run at least some risk of creating financial losses for the CCA by reducing load requirements and related revenues. As a result, EBCE will need to throttle the rate at which it promotes PACE financing to their customers based on participation rates and revenue and cashflow projections.

When applied to energy storage CPACE will likely be a common mechanism through which building owners finance their own energy system upgrades. While we do not at this time recommend setting aside special funds for funding PACE programs, outsourced support and cross-promotion of PACE programs through public private partnership or collaboration with existing PACE providers may be possible through a combination of educational outreach and marketing programs with minimal cost. We recommend that EBCE develop and offer similar financing options in-house once a credit rating has been established and low-cost capital is readily available..

Collaborative Procurement

Under a collaborative strategy, EBCE would enter a PPAs and subordinated/senior credit enhancements with an outside partner to deploy storage rapidly without a credit rating. As EBCE works to own a portfolio of DER assets that enable them to generate and store local renewable power and reduce needed wholesale market procurement power purchase agreements and credit enhancements in partnership with C&I customers may provide the best means of acquiring capacity during the first years of operation. By approaching C&I customers and entering into collaborative procurements that use a PPA as the contracting mechanism EBCE can gain access to roof space for solar generation and storage space that otherwise would not be available.

[4] https://www.mcecleanenergy.org/financing/

Potential Partners may include:

- Kaiser Permanente
- Prologis
- Tesla
- Walmart
- ESSAI INC
- Western Digital
- Calm at
- Schnitzer Steel

We recommend that collaborative procurement is used immediately to begin the development of solar plus storage projects. This strategy is likely to work best for projects that involve both new solar generation and storage capacity. On bill financing is likely a better mechanism for standalone storage once a credit rating has been established, as it allows for EBCE to purchase a storage system that is placed in a customer's building for payback over time from bill reductions that occur from avoided power purchases. Eventually, EBCE could consider offering C&I customers to host EBCE-owned energy storage assets in return for some peak-shaving and reliability (i.e., backup power to critical loads) benefits, while retaining primary control over the asset for load shaping and virtual power plant applications.

At Risk Contracting:
While at-risk or "pay-for-performance" contracting is covered in the outsourcing section of this report it can be specifically used for energy storage to promote new projects on an as-needed bases. Under the model, EBCE would design a repeatable solicitation process designed to engage Energy Service Companies able to offer their own financing, program design, and implementation process. We recommend that at risk contracting be considered in the long term after 2023.

To be successful as an energy storage strategy EBCE would need to.

1. Baseline customer current energy use by sector and property into an anonyms format
2. Define savings or capacity goals to be met by outside bidders
3. Pre-define payment terms, non-disclosure requirements, & contract terms for RFP
4. Pre-define ranking and scoring criteria for selecting winners
5. Release target portions of the data to the public and ESCOs for analysis and subsequent project RFP
6. Apply ranking criteria and select contract winners
7. Monitor and support program implementation and installation of storage equipment
8. Compare new energy use after installation to customer to old baseline and reward outside contractor based on agreed upon payment terms

Key C&I Market Recommendations:

1. Establish NEM rates and TOU pilots for select C&I customers immediately
2. Promote CPACE programs in education and outreach campaigns and connect C&I customers to private sector CPACE financiers
3. Use PPAs beginning in year one of operation to procure local solar plus storage capacity. Include buy-out clause in contract to allow for transition to EBCE ownership in year 6+ once credit worthiness is established
4. Consider at risk-contracting strategies combined with transparent data practices to promote ESCO model projects that are compensated on a pay for performance basis

Strategy	Potential Impact (MW Under Capacity by 2023)	Long Term Impact (2023-2030)	Capital Costs	Staffing Requirements
C&I NEM	3MW	5+	None	NT: 1 LT: 1-2
CPACE	0MW	3+	None	NT: 0 LT: 1
Collaborative Procurement	5MW+	7+	None	NT: 1 LT: 1
At-risk Contracting	0MW	5+	None	NT: 0 LT: 0
TOTAL:	**8MW**	**20MW+**	-	-
NT: Up to 2023, LT: After 2023				

Table 2: Commercial Market Strategy Impact and Implementation Requirements

IV. Virtual Power Plant Aggregation

By year six the implementation of an energy storage contracting strategy should result in large storage capacity throughout the EBCE service area. However, these assets will be distributed across ownership within either direct EBCE control, residential, commercial or industrial markets. To unlock the true value of a distributed energy network EBCE will need a market place or resource management platform able to throttle and control the use of stored energy during periods of peak load to offset the need for wholesale procurement.

A Virtual Power Plant comprised of all the distributed energy systems in EBCE's area has the potential to allow the organization to offset its need for wholesale procurement during peak hours, react to transition loss or service disruption, and generate new energy streams, regulate frequency and transmission requirements, and enable energy arbitrage. While the value stack of the multi-use case of storage is still evolving through the CPUC[5] and the benefits of storage are spread across building EBCE will find opportunities for maximizing the value of storage through a high-tech live interpretation of energy use, production, and storage capacity.

While the LDBP Project Team believes that a virtual power plant platforms will be utilized by California CCAs in the future, we also recognize that market is still maturing and undergoing change. There are no working VPP's currently deployed at the scale that would be most beneficial to EBCE, though there are working pilots emerging throughout the state and the technology is maturing rapidly. As a result, we strongly recommend that any incentivizes, direct installs, or collaborative procurements of DER systems (including energy storage) include a control clause that allows EBCE to either 1. Assume ownership of the asset once credit worthiness is established, or 2. Allow EBCE to aggregate the capacity and control of a distributed asset into a virtual power plant application likely within the next ten years of operations.

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[5] http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M198/K354/198354720.PDF

Conclusion

Under the Skinner mandate 1% of EBCE's peak load is required to be under energy storage contract by 2020, resulting in a requirement for ~14 MW of storage by 2023. Compliance is possible through a combination of residential and commercial programs.

In the residential market we estimate that in the near-term CARE customer giveaways can support the deployment of 1MW of BTM storage capacity. Residential NEM/TOU rate pilots can provide 5 MW of capacity, resulting in 6 MW of residential energy storage capacity by 2023.

In the commercial sector, NEM/TOU pilots are estimated to yield 3 MW of BTM energy storage capacity, and Collaborative procurement efforts are estimated to provide 5 MW+ of FTM commercial storage capacity by 2023. Together these two strategies provide 8 MW of storage capacity in the commercial market.

When combined, these residential and commercial programs will allow EBCE to meet or exceed the Skinner storage mandate by providing 14 MW of BTM and FTM energy storage, or more depending on the scale of collaborative procurement.

After 2023 and construction of contracted storage projects is complete, EBCE will be positioned to deploy other strategies to create new storage capacity. Doing so will move EBCE beyond compliance with the Skinner mandate and importantly will also create the ability for EBCE to capture more value from local energy. A Virtual Power Plant Aggregation in year 6+ of operations will enable energy storage to act as a primary resource for EBCE, and support an advanced automatic demand response program able to offset the need for wholesale energy procurement, insulating EBCE from market price risk and high purchase creating a resource able to contribute to keeping rates low.

Within the context of EBCE's innovative Local Development Business Plan, energy storage plays an critical role in the retention of local energy, while simultaneously creating new revenue streams and cost savings opportunities for residential and commercial customers, as well as supporting EBCE's decarbonization and job creation goals. By working now to meet established targets, and begin implementing programs that build an energy storage portfolio EBCE can create improved financial, environmental, and social outcomes within its service area.

Appendix: Additional Notes on Energy Storage Applications and Technology

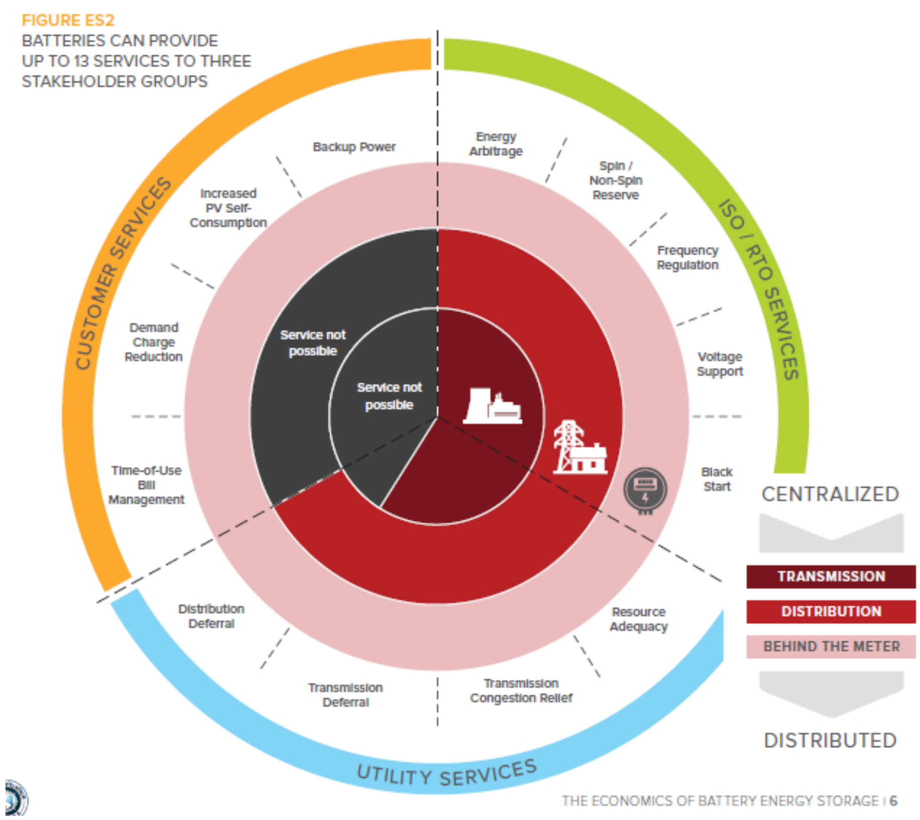
Current Market Costs and Value Additions of Energy Storage

As EBCE begins to develop and procure more local renewable energy sources storage will pay an important role in addressing the intermittent and variable nature of renewable generation. The inclusion of a strong storage strategy will allow EBCE to create new revenue streams from renewable energy resources and grow the size and value of their energy asset portfolio. In addition, by considering energy storage within LDBP and IRP EBCE can provide better service, create local resilience, reduce the need for new transmission and distribution infrastructure, and insulate itself from risks associated with stand-alone renewable energy generation.

Storage Use Cases

When deployed behind the meter the Rocky Mountain institute reports that decentralized consumer facing storage creates thirteen distinct use cases for energy storage. These opportunities include benefits to three distinct stakeholder groups including “customers, utilities or independent system operators/regional transmission organizations (ISO/RTO).”

RMI takes this analysis further and importantly concludes, “The further downstream battery-based energy storage systems are located on the electricity system, the more services they can offer to the system at large.” Out of the three levels of energy storage application behind the meter customer services create the only context in which all thirteen applications are possible.



Perhaps the most valuable service provided by energy storage is backup power. The ability to keep the lights on in the event of unforeseen events such as storm, blackout, or urban unrest can in some cases save lives by allowing for emergency response. Essential service centers such as hospitals, public meeting places, or police and fire buildings often require diesel backup; a role that can be filled by batteries plus storage. As a result energy storage planning overlaps closely with local resilience and emergency planning and energy storage development should include contingent risk planning for emergency use.

As part of our solar siting survey for EBCE our team has identified 650 MW of potential new generation within EBCE territory. Supplementing any selected and developed renewable assets with ESS capabilities will allow EBCE to unlock new revenue streams and provide essential energy services that benefit both customers and utility services.

By screening new solar generation sites for their fit to solar EBCE can identify which sites make the most sense for an ESS. Sites with high demand charges, locations with congested feeders, or feeders that are close to capacity at peak solar-production hours all represent storage opportunities. In addition, by looking for behind-the-meter customer benefit EBCE can supplement utility service benefits such as transmission deferral, congestion relief, resource adequacy, and distribution deferral with customer services such as time-of-use (TOU) bill management, demand charge reduction, increased PV-self consumption, and backup power opportunities. It is also notable that when added to solar pv systems energy storage unlocks the ability to further displace the need for wholesale energy procurement, a practice that ultimately will lower energy costs and greenhouse gas footprint.

One method for identifying sites energy storage is by mapping all the buildings equipped with diesel backup generators such as hospitals, police buildings, and commercial buildings. For these buildings energy storage can act as fuel switching and result in increased electrification. As a business model driven by kWh sales storage based fuel switching can help build EBCE’s revenues and lower Alameda’s Counties use of diesel power. Incentivizing fuel switching can be accomplished in a number of ways and EBCE should consider rebate and incentive programs as well as work to identify outside energy storage providers who are willing to cover some of the capital costs of installation in return for the ability to generate revenue from TOU bill management or energy arbitrage.

Transactional Grids Case Study:

New business models for renewable energy are emerging that create a market for residential system owners to trade their power through an online platform backed by data services and blockchain technology. Solar plus storage projects provide the opportunity for a more transactional and real time grid to be developed under which EBCE can begin to incentivize customers to sell or reduce load to meet system wide demands.

In Brooklyn New York Lo3 Energy has installed 200 smart meters to combine with rooftop photovoltaic installations.

> "In houses that produce renewable energy, the meters record the supply and send it to a custom-built blockchain. Neighbors of these producers have their own smart meters, which act as their nodes on the blockchain, informing them of the energy available. A smartphone application then ties the whole thing together."[6]

The project allows for neighbors to track and trade in real time their renewable energy supply and demand and establish a market price for the energy through a smartphone application. Ultimately, project is an example of the types of service that EBCE may consider to pilot and roll out as a customer program. As data and information technology services become integrated with basic metering and TOU structures the basis for the smart grid can be created. CCA's should start to consider how to deploy these smart features and act as a clearinghouse for local renewable energy. By creating a customer accessible virtual powerplant EBCE can reduce the need for wholesale energy procurement and facilitate a local market that keeps the costs and revenues from energy generation within the local community.

Storage Costs and Value
It is generally accepted that the rate of technology innovation has outpaced the development of new business models and revenue streams. As a result EBCE should consider both current costs of storage as well as monitor new innovations in technology and cash flow structuring.

A 2014 report, *Electrical Energy Storage Systems: A comparative life cycle cost analys*is, by Zakeri and Syri provides "an updated database for the cost elements (capital costs, operational and maintenance costs, and replacement costs)." The report highlights several emerging and established energy storage technologies and reports their lifecycle costs. Zakeria's and Syri's report:

> "3.2.2. Lifecycle costs (LCC) from an ownership perspective, LCC is more important indicator to evaluate and compare different EES systems. LCC accommodates all the expenses related to fixed operation and maintenance (O&M), variable O&M, replacement, disposal, and recycling, in addition to TCC. LCC can be presented in levelized annual costs (€/kW yr), which is the yearly payment that the operator should maintain for all services of EES, including repayment of the loan and up front of the capital costs. Schoenungand Hassenzahl [106] propose the term revenue requirement in (¢/kWh), which can be used by an energy supplier to calculate all the operating and ownership costs required for discharging each unit of stored energy in kWh."

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[6] https://spectrum.ieee.org/computing/networks/blockchains-will-allow-rooftop-solar-energy-trading-for-fun-and-profit?utm_source=Sailthru&utm_medium=email&utm_campaign=Issue:%202017-10-05%20Utility%20Dive%20Solar%20%5Bissue:12312%5D&utm_term=Utility%20Dive:%20Solar

Zakeria's and Syri's review the LCC of several ESS for both for bulk energy storage and transmission and distribution (T&D) The table below captures the range of Annualized Life-Cycle Costs of these technologies:

Annualize Life-Cycle Costs, ALCC (€/kW-yr)

B. Zakeri, S. Syri / Renewable and Sustainable Energy Reviews 42 (2015) 569–596 587

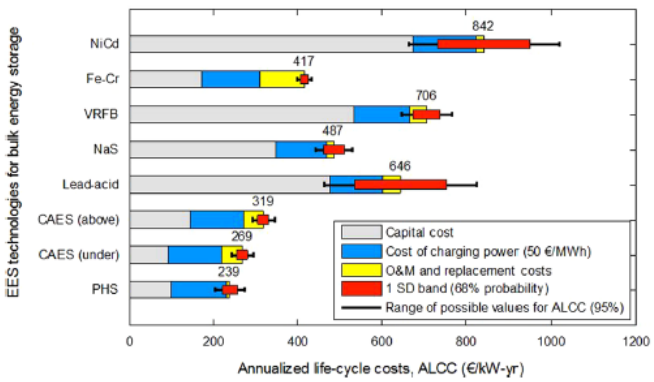


Fig. 9. The annualized life cycle costs (ALCC) of EES systems in bulk energy storage and related uncertainties, considering 250 cycles per year, 8% interest rate and 8 h discharge time (see Tables 8 and 9 for other input parameters). The average values are shown above each bar.

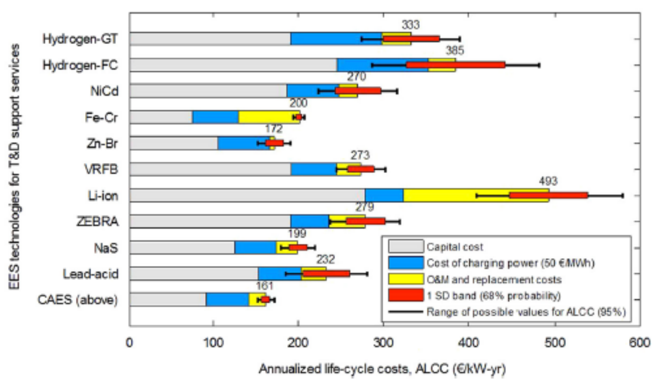
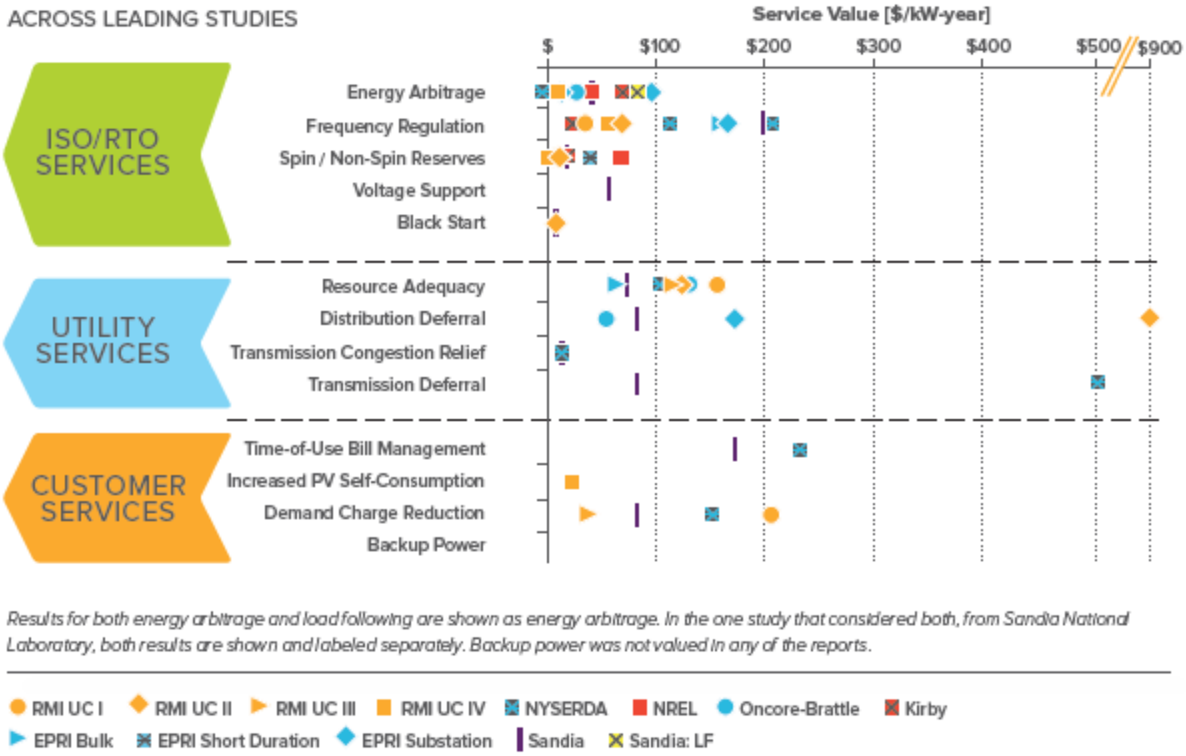


Fig. 10. The annualized life cycle costs (ALCC) of EES systems and related uncertainty for T&D support applications, with 400 cycles per year, 8% interest rate and 2 h discharge time (see Tables 8 and 9 for other input parameters).

The Rocky Mountain Institute highlighted in their 2015 Report The Economics of Battery Energy Storage How Multi-use, Customer-Sited Batteries Deliver the Most services and Value to Customers and the Grid the range of service values ($/kW-year) for thirteen different storage applications.

FIGURE ES1
ENERGY STORAGE VALUES VARY DRAMATICALLY ACROSS LEADING STUDIES



Renewable energy is intermittent and nature and as a result is not provide consistent value to the electricity system at different times of use. Storage provides the ability to bank and release renewable energy in phase with periods of high energy costs, essentially expanding the value of renewables to any time of the day. Currently renewable energy is credited through Net Metering (NEM) policies that pay a flat rate for renewable energy generation, regardless of when that energy was generated. EBCE can create new business cases for storage by moving beyond fixed rate solar payments and develop time of use rules and rates that move beyond NEM. Advanced metering practices that are able to capture more precise and frequent interval data will unlock opportunities for the market to define the most optimal and efficient use of renewable energy generation. Doing so will allow EBCE to fully leverage the value of ESS ability to offset wholesale procurement costs and natural gas pricing risk during on peak and shoulder hours.

Table B1
Technical characteristics of electrical energy storage (EES) systems, based on the review of the references in Table 2.

EES technology	Power range (MW)	Discharge time (ms–h)	Overall efficiency	Power density (W/kg)	Energy density (Wh/kg)	Storage durability	Self-discharge (per day)	Lifetime (yr)	Life cycles (cycles)
PHS	10–5000	1–24 h	0.70–0.82		0.5–1.5	h–months	Negligible	50–60	20000–50000
CAES (underground)	5–400	1–24 h	0.7–0.89		30–60	h–months	Small	20–40	> 13,000
CAES (aboveground)	3–15	2–4 h	0.70–0.90			h–days	Small	20–40	> 13,000
Flywheel	Up to 0.25	ms–15 m	0.93–0.95	1000	5–100	s–min	100%	15–20	20,000–100,000
Lead–acid	Up to 20	s–h	0.70–0.90	75–300	30–50	min–days	0.1–0.3%	5–15	2000–4500
NaS	0.05–8	s–h	0.75–0.90	150–230	150–250	s–h	20%	10–15	2500–4500
$NaNiCl_2$ (ZEBRA)	50	2–5 h	0.86–0.88	150–200	100–140	s–h	15%	15	2500–3000
Ni–Cd	Up to 40	s–h	0.60–0.73	50–1000	15–300	min–days	0.2–0.6%	10–20	2000–2500
Li-ion	up to 0.01	m–h	0.85–0.95	50–2000	150–350	min–days	0.1–0.3%	5–15	1500–4500
VRFB	0.03–3	s–10 h	0.65–0.85	166	10–35	h–months	Small	5–10	10,000–13,000
Zn–Br	0.05–2	s–10 h	0.60–0.70	45	30–85	h–months	Small	5–10	5000–10,000
Fe–Cr	1–100	4–8 h	0.72–0.75					10–15	> 10,000
PSB	15	s–10 h	0.65–0.85			h–months	Small	10–15	2000–2500
SMES	0.1–10	ms–8 s	0.95–0.98	500-2000	0.5–5	min–h	10–15%	15–20	> 100,000
Capacitors	Up to 0.05	ms–60 m	0.60–0.65	100,000	0.05–5	s–h	40%	5–8	50,000
SCES	Up to 0.3	ms–60 m	0.85–0.95	800–23,500	2.5–50	s–h	20–40%	10–20	> 100,000
Hydrogen (fuel cell)	0.3–50	s–24 h	0.33–0.42	500	100–10,000	h–months	Negligible	15–20	20,000

Table C1
Total capital cost (TCC) of grid-scale EES systems based on the review of the sources listed in Table 2.

EES technology	Configuration	Total capital cost[a] (TCC), per unit of power rating €/kW			Total capital cost (TCC), per unit of storage capacity[b] €/kWh		
		Min	Average	Max	Min	Average	Max
PHS	Conventional	1030	**1406**	1675	96	**137**	181
CAES	Underground	774	**893**	914	48	**92**	106
	Aboveground	1286	**1315**	1388	210	**263**	278
Flywheel	High-speed	590	**867**	1446	1850	**4791**	25049
Lead-acid	Advanced	1388	**1923**	3254	346	**457**	721
NaS	–	1863	**2254**	2361	328	**343**	398
ZEBRA	–	2279	**3376**	4182	596	**699**	808
Li-ion	–	874	**1160**	1786	973	**1095**	1211
VRFB	–	2109	**2512**	2746	459	**546**	560
Zn–Br	–	1277	**1360**	1649	257	**307**	433
Fe–Cr	–	1099	**1132**	1358	170	**220**	281
Ni–Cd	–	927	**1093**	1308	1071	**1147**	1153
PSB	–	1376	**1400**	1425	527	**569**	611
Zn–air	–	1313	**1364**	1415	262	**271**	417
Supercapacitors	Double-layer	214	**229**	247	691	**765**	856
SMES	–	212	**218**	568	5310	**6090**	6870
Hydrogen	Fuel cell[c] (FC)	2395	**3243**	4674	399	**540**	779
	Gas turbine[d] (GT)	1360	**1570**	2743	227	**262**	457

[a] The capital costs are calculated based on typical discharge time (storage size) for each technology (see Appendix A), which is not necessarily the same among different EES systems. Minimum and maximum values are the bands of interquartile range (middle-50 likelihood) and the average value is the median of whole sample, excluding outliers. It should be noted that the costs of grid interconnections and infrastructure requirements are not included in this estimation.
[b] For the batteries, the storage capacity is equivalent to the rated DoD.
[c] Electrolysis and fuel cell with steel tank storage system.
[d] Electrolysis and small-to medium scale gas turbine with underground storage.

Notes Regarding Thermal Energy Storage (TES) Applications for EBCE

Thermal Energy Storage (TES) can provide a proven and cost effective method for reducing cooling costs for EBCE's commercial and industrial customers. "There are three kinds of TES systems, namely: 1) sensible heat storage that is based on storing thermal energy by heating or cooling a liquid or solid storage medium (e.g., water, sand, molten salts, rocks), with water being the cheapest option; 2) latent heat storage using phase change materials or PCMs (e.g., from a solid state into a liquid state); and 3) thermo-chemical storage (TCS) using chemical reactions to store and release thermal energy."7

The application of TES systems can be deployed to shift the energy demand and supply profiles for building HVAC systems and is beginning to play a larger role in energy management when coupled with "electricity storage in combination with concentrating solar power (CSP) plants where solar heat can be stored for electricity production when sunlight is not available." In addition, the technology has applications in both centralized and decentralized systems. Existing pilot programs established between thermals Storage Company ICE energy and Sothern California Edison (SCE) have been implemented in the form of an Ice Bear equipment handout. The "The Ice Bears will provide a total of up to 25.6 MW of peak storage capacity to SCE under 20-year Power Purchase Agreements (PPA)."[8][9]

Similar programs designed to target high HVAC cooling costs within EBCE service area can provide the opportunity offset the need for peak wholesale purchasing, lowering costs for both the customer and EBCE as a power purchaser. Deployment of TES systems can be sourced through either Pay for Performance contracting strategies or as a direct rebate or incentive program bundled into EBCE's energy efficiency contracting strategy. Successful RFPs designed to procure TES systems are likely to be developed in the near term as collaborative partnerships between EBCE and customers such as grocery stores, college campuses, or industrial manufacturing sites with large heating and cooling needs. Like all storage programs that deploy a power purchase agreement EBCE should include a buyout clause as part of the contract,

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[7] Hauer, Andreas. IEA-ETSAP and IRENA. January, 2013. *Thermal Energy Storage Technology Brief.* Retrieved from: https://www.irena.org/DocumentDownloads/Publications/IRENA-ETSAP%20Tech%20Brief%20E17%20Thermal%20Energy%20Storage.pdf

[8] *Market Wire. April 12, 2017. Ice Energy and NRG Energy Announce Start of World's Largest Ice Bear Energy Storage Deployment.* Retrieved from: http://www.marketwired.com/press-release/ice-energy-nrg-energy-announce-start-worlds-largest-ice-bear-energy-storage-deployment-2209311.htm

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enabling for the CCA to transfer a leased asset into ownership as part of a long term storage aggregation strategy.

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About Optony

Optony Inc. is a global research and consulting services firm focused on enabling government and commercial organizations to bridge the gap between clean energy goals and real-world results. Optony's core services offer a systematic approach to planning, implementing, and managing commercial and utility-grade renewable power systems, while simultaneously navigating the dramatic and rapid changes in the solar industry; from emerging technologies and system designs to government incentives and private/public financing options. Leveraging our independence, domain expertise and unique market position, our clients are empowered to make informed decisions that reduce risk, optimize operations, and deliver the greatest long-term return on their solar investments. Based in Silicon Valley, Optony has offices in Santa Clara, Chicago, and Beijing.

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