Attachment B: Overview of Progress on Activities to Facilitate and Integrate DERs

Summary of Activities

Staff's main role in facilitating Distributed Energy Resources (DER) adoption in recent years has been to lower hurdles to permitting and to interconnect these systems to the City of Palo Alto Utilities Department (CPAU) distribution systems. These efforts included:

- Over-the-counter permit approval for photovoltaic (PV) systems and battery energy storage systems (BESS) that have a capacity of less than 10kW.
- Over-the-counter approval of electrical permits for level 1 and level 2 electric vehicle (EV) chargers and for heat pump water heating (HPWH) and heat pump space heating (HPSH) systems.
- Online Permitting Service (OPS) developed in response to shelter-in-place needs.
- Development of informational material and webpages to assist permit applicants to submit relevant material for over-the-counter permits.
- Ongoing training of internal staff on: permit approval process and steps required to interconnect DER systems, appropriate electric metering equipment requirement, customer communication to sign interconnection agreement, steps to input system information into CPAU databases and billing system, etc.
- A more comprehensive portfolio of customer programs to facilitate EV adoption was put in place using Low Carbon Fuel Standard (LCFS) funds from the state.
- Implementation of a residential HPWH pilot rebate program. Except for EV related customer programs, cost-effective energy efficiency programs for customers, and income qualified customer programs, funding available to provide cash rebates for other DER technologies for customers is rather limited.
- In the process of developing cost-based electric rates that support residential electrification.

Integration initiatives of DERs of residential customers have been limited due to the lack of advanced meters, but efforts are underway to optimize a PV+BESS being installed at a commercial campus in town. As outlined in the staff report, due to the relativly early stages of DER adoption, the availability of sufficient capacity in the distribution system to accommodate low to medium penetration of DERs, and the unavailability of advanced meters until 2024, Palo Alto's initiatives to integrate DERs are in its nascent stages.

Described below are two initiatives to optimally integrate customer-sited DERs. The first is the distribution transformer loading analysis project (currently underway) and the second is the evaluation of potential DER customer pilot projects.

I. Transformer Loading Assessment with Data Loggers at Four Locations – Single Family and Multi-Family Customer Locations

As discussed earlier, the impact of DER adoption on the distribution system will initially occur in the loading of residential distribution transformers. While PV or BESS resources could reduce the

load on a transformer, EV, HPWH, and HPSH will increase the load on a transformer. Although transformers can handle some overloading on a regular basis for limited durations, continuous overloading of the transformer above rated capacity for an extended period will shorten the life of the transformer, resulting in premature failure. Since the damage to the transformer is from the heat buildup in internal components, overloading during a summer heatwave (where transformers do not have the ability of cooling overnight) increases the likelihood of failure and resulting outages to customers. This could be exacerbated by programs that encourage customers to shift loads to off hours, which also impacts the ability for transformers to cool.

Unlike some of the neighboring utilities, CPAU has historically been conservative in sizing transformers[1], hence has avoided transformer burn-outs. However, as EV penetration increase in neighborhoods and EV charging loads increase, the risk of such overloading increases. Staff proactively runs system reports, based on longstanding algorithms, on estimated transformer load to monitor loading. An assessment is underway to monitor transformer loading in 10-minute intervals using data loggers at four locations to further refine the algorithm/calculation of transformer load, incorporating the current customer load profiles, including EV charging loads.

The four transformers were selected based on CPAU Engineering's 'Service Connection-Transformer Connectivity Map' and DMV EV registration data helped identify distribution transformers with largest numbers of EVs connected. The objectives of the 18-month study is to: a) to assess whether the current models (used over the past 20-years) used to predict transformer loading is still valid for neighborhoods with high EV penetration; and if not, begin modifying the current algorithm model based on the actual transformer loading information from the loggers, b) field verify the accuracy of the 'Service Connection-Transformer Connectivity Map' and update the connectivity map as needed, and c) evaluate the voltage profile at the transformer to gather insights on the distribution feeder operating characteristics and compare it with feeder voltage models. The study is expected to be completed by the end of summer 2021.

[1] Palo Alto's transformer loading models have tended to oversize transformers, primarily for economic and reliability purposes. Since only 20% of the cost of a transformer installation is the cost of the transformer and the remaining 80% cost is driven by fixed cost labor to mobilize and mount the transformer (irrespective of size), CPAU has found it to be prudent to oversize the transformer. Such oversizing also reduces the risk of a transformer burn-out.

Description of Neighborhood Distribution Transformers Being Monitored for Loading and Voltage Profiles

Transformer/ Load Profile	Transformer A (#6492)	Transformer B (#6504)	Transformer C (#6747)	Transformer D (#6998)
Transformer Profile				
Transformer Phases	ABC	ABC	BC	ABC
KVA Rating	75	37.5	25	25
Map Number	C7	G8	G10	F7
Current Vault/Pole #	PAD	PAD	PAD	PAD
Connected Load Characteristics				
Electric Vehicle Quantity	4	6	6	3
Service Points	35 (single- and multi-family homes)	8 (all single-family homes)	10 (all single-family homes)	7 (all single-family homes)
Service Points w/ EVs	4	4	4	3
Plug-in Hybrid EVs	1	2	0	1
Battery EVs	3	4	6	2
EV Chargers Level #2	1	2	0	0
EV Chargers Level #3	0	1	0	0

Note: Upon the implementation of AMI, the transformer loading and voltage profile analysis will be done on all transformers on an automated basis, without the need to install data loggers.

II. Evaluation of DER Related Customer Pilot Projects

Listed below is a brief outline of potential DER-related pilot projects being evaluated to facilitate adoption and integration. Among the projects outlined, one or two projects are likely to be selected for implementation in the coming years. The project(s) selected for implementation will be highly influenced by staffing availability, value of the pilot for the targeted customer segment, and fit of the pilot project within the portfolio of CPAU customer programs.

1. Consider partnerships with commercial customers who are considering BESS investments in the hundred-kW scale. After meeting customer-specific needs, the partnership would co-optimize the value of the system to meet the Palo Alto community's needs as a whole.
2. Consider facilitating residential customers in charging batteries of their electric vehicles only during low value electricity generation periods and not charging (demand response) during periods when the system peaks for the month or for the year[2].
3. Consider incentivizing homes that install electric heat-pump water heaters to invest in control technologies which will enable customers to shift the devices' electrical loads to coincide with low electricity price and low emission periods of the day[3].

[2] CPAU is not currently contemplating any pilot projects related to *discharging* EV batteries to serve loads during high electricity value periods (vehicle to grid).

[3] Electrical load of HPWHs are much lower than those of an electric resistance water heater, but all electric water

4. Consider incentivizing the installation of PV+BESS at income qualified homes for improved resiliency, along with additional rebates for EV charger installation and EV purchases.
5. Consider implementing an updated demand response program for commercial customers and/or a flexible EV charging program for residential customers.
6. Consider promoting customer-installed smart electric panels, panels that manage customer loads within existing electrical panel capacity, instead of upgrading their electric panel capacity[4].

The implementation of a pilot project(s) will be highly dependent on the project value and staffing resources needed for implementation.

heaters have the capacity to move their electrical load to lower value electricity production periods during the day, currently between 10am and 3pm.

Staff is not contemplating incentivizing other thermal energy storage technologies (TES) at this time. Ice-storage based TES systems in residential and commercial customer sites are still viable in the Central Valley where the peak demands increase sharply during the summer and such systems improve air conditioning compressor efficiencies and lower loads during hot-weather, high peak load periods, but provide less value in Palo Alto where the summer is milder.

[4] Such smart electrical panels have the potential to reduce the peak demand of the customer on the distribution system. Staff is in the process of evaluating the effectiveness of these smart panels. If considered effective from a customer or rate payer perspective, staff will publicize these systems and consider providing rebates for the installations as part of the building electrification program.