ATTACHMENT 2
Executive Summary – Aquifer Pumped Hydro Group 1

Project Description: Aquifer Pumped Hydro (APH) energy storage provides a 10-hour energy discharge at 200 kW. It can be installed at sizes of 50 to 1000 kW. It also provides power during PSPS outages for 100+ hours. This makes it a 2-for-1 energy solution. Existing wells are retrofitted to provide power in a smaller, more flexible version of pumped storage hydro. The aquifer is the lower reservoir. Groundwater is pumped up to the upper reservoir at ground level. The upper reservoir size determines the duration of energy discharge. During the evening ramp-up, water in the upper reservoir will be injected down the well hole to generate power. The well motor runs in reverse as a generator. It can be installed in a flat area. It is a proven technology that is operational at sites in the western US. Willow Springs Water Bank (WSWB) will apply APH to the California grid.

The flat Central Valley has over 100,000 wells. They could be retrofitted to release energy. Each well could become a small energy storage facility. The economics are favorable because most of the needed infrastructure already exists in the form of idle irrigation wells. Use of existing wells provides economic, rapid, distributed, and scalable implementation. The economics of APH are improved if the water used for injection is also needed for basin recharge. The Sustainable Groundwater Management Act (SGMA) will require large amounts of additional recharge to correct the severe overdraft problem in the Central Valley. Using recharge water for injection improves the economics for wells that are idle due to SGMA or due to poor water quality.

Retrofitting existing wells to store energy provides a longer life cycle than a lithium battery, has no thermal runaway issues, and does not produce a waste disposal legacy. APH uses local groundwater in a closed loop or imported water from canals. This provides energy for the evening ramp up or during a PSPS outage when the grid is down. Ubiquitous wells are available to provide emergency power to low income and disadvantage communities, especially in the Central Valley. This will result in job creation in low income communities that will be hit hard by land fallowing due to SGMA.

Project Goals and Objectives: This project's two goals are to demonstrate that (1) APH provides long duration energy storage reliably and (2) that it provides emergency power during a PSPS outage. The objectives of this project include (a) 10 hours of discharge, (b) 200 kW of peak power production, (c) quantification of the "energy in, energy out" for energy storage, and (d) supply to critical facilities like hospitals, nursing homes, and charging centers when the grid is down. The objectives will be met with a one-year operational demonstration. 200 kW of power will be discharged during the 5 on-peak hours on each of the 5 weekdays. 25 hours of energy storage will be recharged by refilling the reservoir off-peak on the weekend. APH will also absorb surplus renewables in the winter and spring by recharging during the super off-peak. 10 hours of continuous power will be available for PSPS events using the onsite reservoir; if imported water is available, PSPS power would be available for 100+ hours.

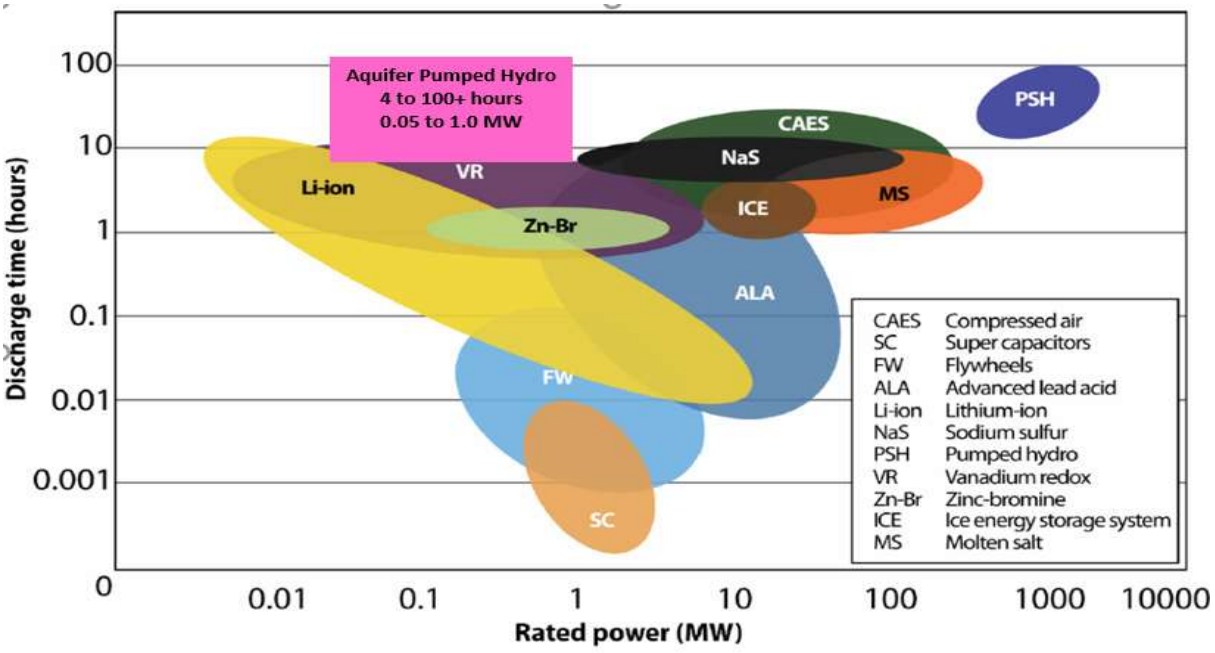
Achievement, Quantification, and Measurement: The cost of retrofitting existing wells for APH to store energy will be quantified. The amount of peak hour energy produced will be measured and timed. This will result in a $/kWh cost. The current capacity cost estimate of $380/kWh is less than a lithium battery at about $470/kWh ($1880/kW of power, 4 hours). Metrics will be developed to assess power, duration, storage capacity, life cycle, capacity costs, installation time, and storage density. Applicability to other parts of the state will be assessed, including a template for where it can be best installed, at what cost, and how low

income and disadvantaged communities may benefit. Metrics will also be developed to assess waste production, safety, and leakage risks.

Demonstration Description: A 200 kW storage system will be built at WSWB using 5 existing wells. They will inject both local groundwater and imported water. A 2-year design/build process will install power regeneration retrofits for the wells. An onsite reservoir and connection to imported water will be built, leveraging the value of over $30 M of existing WSWB facilities. These facilities will be operated for one year to demonstrate that 10-hour discharges can be produced reliably during the evening ramp up and 100+ hours during PSPS events. This second-generation demonstration. Once the project is complete, APH will be ready for statewide commercialization

Agreement Management: The WSWB team is a group of proven professionals. All task leads have graduate degrees and/or professional certifications. This will provide the credibility needed to ensure that there are no hidden flaws. They have worked together successfully on prior CEC-funded projects. This ensures that the project will be completed on time and on budget. The project has completed CEQA already (EIR in 2006, Addendum in 2018). Match funding has been acquired in the form of a FEMA grant. The site is available, partially built out, and already an operating facility.

Niche APH occupies a unique energy storage niche (see figure below). Its development is the culmination of two prior successful CEC EPIC grants (EPC15-049 and EPC 16-029). It provides 10 hours of discharge at 200 kW at a lower cost than a lithium battery. It is smaller than conventional pumped storage, is scalable, and can provide energy in flat areas. It uses using existing infrastructure to provide distributed energy storage that has transmission, distribution, and end-user benefits. It also provides continuous power during PSPS events.



Source: Adapted from the Energy Storage Association