



# Memorandum

January 24, 2019

**To:** Cody Roggatz, Director of Aviation; Hank Seemann, Deputy Director of Environmental Services – County of Humboldt  
**From:** Jim Zoellick, Managing Research Engineer - Schatz Energy Research Center  
**Cc:** Peter Lehman, Founding Director; David Carter, Managing Research Engineer - Schatz Energy Research Center; Matthew Marshall, Executive Director; Dana Boudreau, Operations Director; Lori Biondini, Director of Business Development and Planning; Richard Engel, Director of Power Resources – Redwood Coast Energy Authority  
**Re:** Redwood Coast Airport Renewable Energy Microgrid Memorandum of Understanding


The County of Humboldt (County), the Redwood Coast Energy Authority (RCEA), and the Humboldt State University Sponsored Programs Foundation/Schatz Energy Research Center (SERC) are partnering to develop a solar powered microgrid at the California Redwood Coast - Humboldt County Airport (Microgrid). The purpose of this memo is to provide a brief description of the project, summarize project benefits, and provide a context for and brief summary of the Memorandum of Understanding that has been proposed among these three entities.

## **Project Description:**

The Redwood Coast Airport Renewable Energy Microgrid Project will establish a microgrid at the California Redwood Coast - Humboldt County Airport. According to the U.S. Department of Energy, “A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.” This will be Pacific Gas and Electric Company’s (PG&E’s) first front-of-the-meter, multi-customer microgrid. The system will feature over 2 MW of solar electricity (the largest solar array in Humboldt County and capable of powering more than 350 households) and 8 MWh of battery energy storage. The system will be capable of powering the airport and Coast Guard Sector Humboldt Bay Air Station for extended periods in the event of a widespread, extended power outage in the region. Attachment A provides a plan view drawing and an artist rendition of what the system will look like.

The solar electric and battery energy storage systems will belong to the Redwood Coast Energy Authority. During normal daily operation, the system will be managed to provide clean, local renewable power to RCEA’s customers. In addition, a separate 300 kW solar electric system will provide power directly to the airport terminal, saving the airport roughly \$50,000 per year. In the event of a local power outage, the Microgrid will disconnect from the larger electric grid and will provide power to the airport and Coast Guard station. Attachment B provides a brief discussion and schematics that explain the operation of the Microgrid system.

Key partners in this project include the County, as owner and operator of the airport, RCEA, as owner and operator of the solar electric and battery energy storage systems, and SERC as the lead project engineer. The total project cost is expected to be approximately \$11M. To support the project, SERC received a \$5M grant from the California Energy Commission and RCEA is securing a \$6M loan from the USDA Rural Utility Service. The other key project partner is PG&E. PG&E will continue to own and maintain the distribution system that



serves the airport and surrounding facilities. They will also continue to handle all billing and customer service functions in partnership with RCEA. PG&E will continue to be responsible for the safe and reliable function of the electric grid serving the airport facilities, including during both grid-connected and islanded operation of the Microgrid.

**Project Benefits:**


This project has many benefits to the County.

- Reduces operating costs at the airport. It is estimated that the 300 kW PV system directly serving the airport will generate an average of 430 MWh/yr. This will offset the airport's energy usage and is expected to save the County approximately \$50,000 per year on their electric bills. The County will receive a performance guarantee that the system will produce at least 350 kWh/yr, and they will be compensated by RCEA if production drops below this level. See Attachment A for an explanation of how these economic benefits were calculated.
- Adds resilience for the airport and Coast Guard air station. The microgrid will provide reliable backup power during extended periods when the larger utility grid is out of service. The airport and Coast Guard station will receive a more secure supply of electrical power that does not rely on outside sources of energy or fuel. This is particularly important in times of a natural disaster when Humboldt County could be isolated for weeks from the outside world and the only method to get supplies in and out of the County would be via aircraft.
- Adds electric vehicle charging at the airport. The Microgrid project will install four electric vehicle chargers at the airport. This will serve to attract customers, improve the service level that customers receive, and decrease the airport's environmental footprint.
- Improves marketing image of the airport. The Microgrid project will "green" and modernize the airport by installing solar electric generation, electric vehicle charging stations, and cutting-edge microgrid technology that will lower operating costs, improve resiliency and reduce the facility's environmental footprint.
- Provides clean, renewable power for Humboldt County residents. RCEA has established a Community Choice Energy program that provides the generation component of electricity service to 93% of eligible electricity customers in Humboldt County. A key goal of this program is to develop local renewable power resources. This project will develop local renewable power as a way to improve regional energy security, create local jobs, and keep energy dollars flowing in the local economy.
- Creates local jobs and economic activity. Conservative estimates of job creation benefits indicate that implementing the Microgrid project will result in an estimated 37 FTE during the construction phase with \$1.5M in earnings and \$3.4M in economic output. Approximately 0.2 FTE jobs per year will be supported during sustained operations with an associated \$10,000 per year in earnings and \$14,600 per year in economic output.
- Reduces greenhouse gas emissions. The 300 kW solar electric array serving the airport will offset approximately 130 metric tons of CO<sub>2</sub> per year as a result of the clean electricity generated. This will help the County achieve its greenhouse gas reduction targets.

**Memorandum of Understanding:**

A Memorandum of Understanding (MOU) has been developed between the County of Humboldt, the Redwood Coast Energy Authority and the Humboldt State University Sponsored Programs Foundation/Schatz Energy Research Center (the Parties). The MOU sets forth the terms and understanding between the Parties with regard to the development, design, installation and operation of the Microgrid at the California Redwood Coast - Humboldt County Airport.

The MOU describes the roles and responsibilities and details how the costs and benefits associated with the Microgrid project are shared among the Parties. The intention of the MOU is to establish a clear framework that leads to successful execution of the Microgrid project. The MOU covers the project development, installation, and start-up period, and as such will terminate on March 31, 2023. This coincides with the end of



the California Energy Commission grant period. The MOU will be supplemented by additional agreements that will cover the full term of the project. For example, a Lease Agreement between the County and RCEA is being developed and will cover the 25 year lease for the approximately 9 acres of airport property that the Microgrid system will occupy.

## **Attachment A: Explanation of how the Redwood Coast Airport Renewable Energy Microgrid will reduce the airport's electricity costs**

The Redwood Coast Airport Renewable Energy Microgrid is expected to save the County of Humboldt about \$50,000 per year on their electricity bills. This attachment explains how this arrangement will work.

### **Overview**

The project will feature a large solar electric array. Physically, the power from this solar electric array will serve electrical loads at and in the near vicinity of the airport. Contractually, however, the power from the array will serve two separate entities: RCEA and the County.

RCEA will own, operate and maintain the overall facility. The total estimated cost of the installed hardware for the system is about \$9.2M. RCEA is covering about \$6M of these costs. The remainder will be covered by a grant from the California Energy Commission.

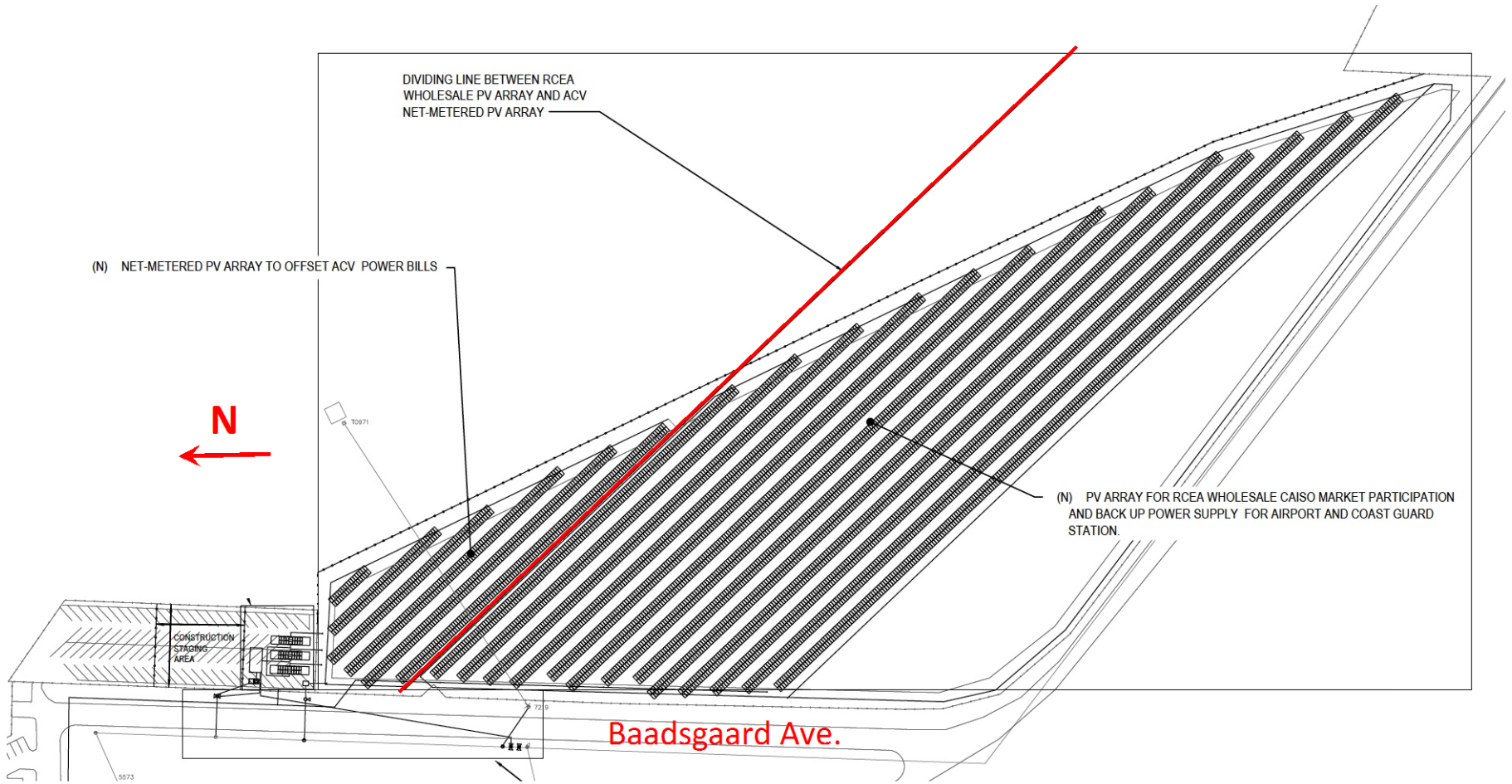
The solar electric system will occupy about 9 acres of land at the airport. With FAA approval, RCEA and the County are negotiating a 25-year lease for the property. The lease payment to the County will be in the form of a portion of the electricity generated by the solar electric array. This solar electricity will directly offset the County's electricity consumption at the airport and is expected to save the County about \$50,000 per year on their electric bills.

### **Redwood Coast Airport Renewable Energy Microgrid**

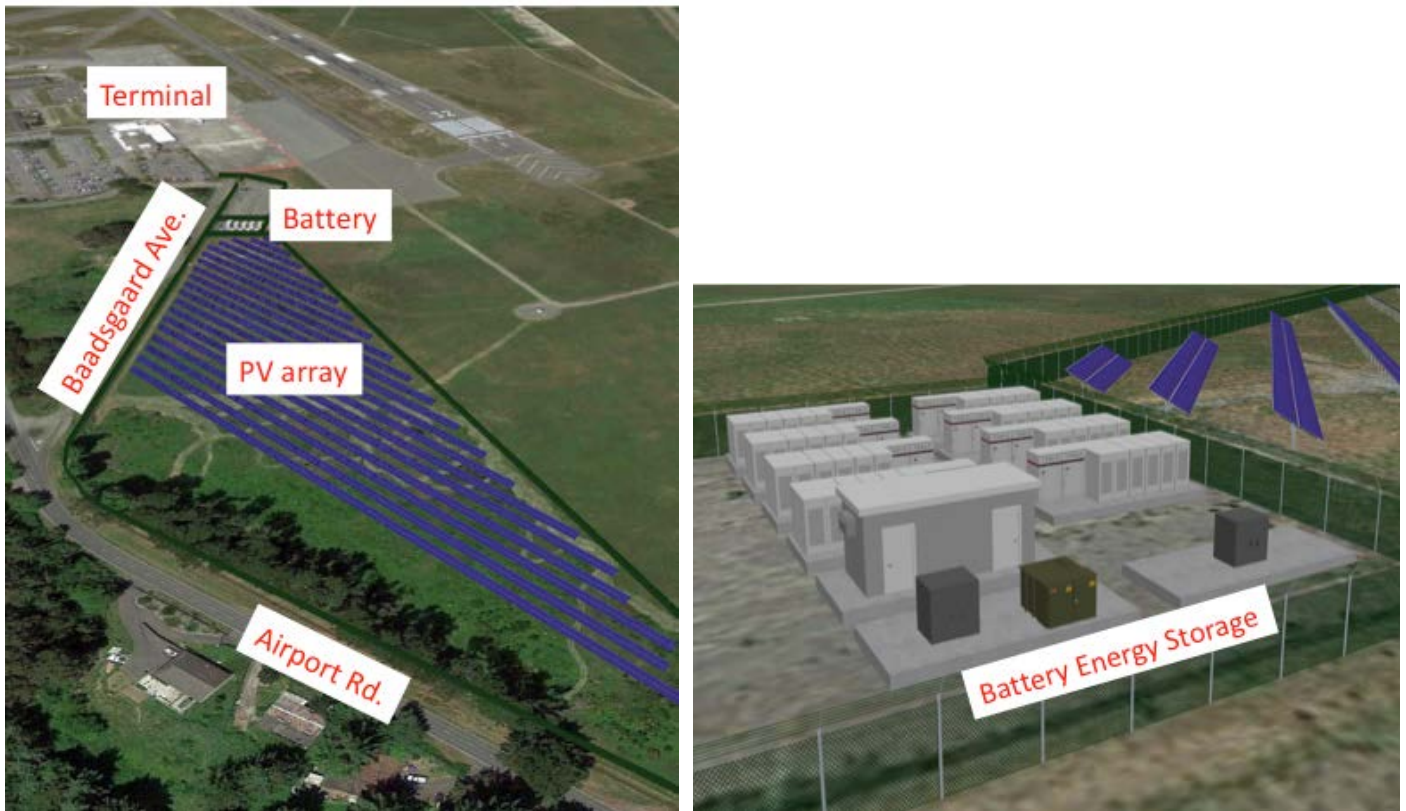
The Redwood Coast Airport Renewable Energy Microgrid will be composed of a roughly 2.3 MW solar electric array, a 2 MW/8 MWh battery energy storage system, and smart microgrid controls that will allow the system to operate independently of the larger electric grid. The system will be located along Baadsgaard Avenue as shown in Figure 1.

As can be seen in Figure 1, the northern portion of the solar array (located at the left edge of the array) will be dedicated to directly serving the airport terminal and other airport facilities, and in this way will offset airport electric bills. This 300 kW array will be connected to the grid through an arrangement called net metering (discussed in the next section).

Figure 2 shows an artist's rendition of the PV array and battery energy storage system.



**Figure 1. Plan view drawing of PV array and battery energy storage showing net-metered PV array at north end**



**Figure 2. Artist's rendition of the solar electric array and battery energy storage system located along Baadsgaard Avenue**

### **Aggregate Net Metering**

The 300 kW PV array that will directly serve County electrical loads will be connected through its own electrical service and PG&E account. The power from the PV array will serve multiple airport electrical accounts, including the main airport terminal building and some of the runway lighting. This will be accomplished through an arrangement called aggregate net metering.

Typically, "net metering" applies to a facility that has a solar electric system installed on its roof, with the PV array tied into the facility's electric service panel on the customer side of the PG&E electric meter. Therefore, the PG&E meter only sees the net load from the facility, and if the PV array is producing excess power, then that power flows through the PG&E meter and provides power to adjacent facilities. When excess power is generated and exported to adjacent facilities there is a credit posted to the electric account of the facility that is hosting the PV array. On an annual basis the charges are "trued up" and the customer pays for their net consumption over the year.

Aggregate net metering works in a similar fashion, except with aggregate net metering there is one generating account and multiple load accounts. Whatever is produced by the generating account is credited to the load accounts. In this way, net metering applies to the aggregate of the generation and load accounts.

### **Solar Electricity Production and Cost Savings Estimates**

The cost savings estimates attributable to the 300 kW net-metered PV array were determined using standard, industry accepted software and methodologies. The PV production estimates were generated using the National Renewable Energy Laboratory's System Advisor Model. This model incorporated equipment characteristics and estimated weather files for the California Redwood Coast – Humboldt County Airport and was used to produce hourly estimates of solar electricity generation. The value of this electricity was then determined based on the time varying cost of electricity, which is defined by the rate tariff for the facility (for example, the main airport terminal is on PG&E's E19 rate tariff).

It is important to note that these calculations are estimates. It is impossible to know what the weather will be like in the future, so there is uncertainty in the estimated solar electric generation. In order to assess the likely variation in solar output as a function of varying weather conditions, an analysis was performed using 19 years of past weather data for the airport. These weather files were used to estimate the output from the system over its 25-year life. The average expected output was determined to be 428,000 kWh/yr, and the minimum likely output was estimated to be approximately 370,000 kWh/yr.

Based on these estimates, a performance guarantee was agreed upon between RCEA and the County of Humboldt. That guarantee states that if the PV array produces less than 350,000 kWh in any given year, RCEA will reimburse the County of Humboldt for the value of the lost energy.

## **Attachment B: How will the Redwood Coast Airport Renewable Energy Microgrid provide resilience to the airport and U.S. Coast Guard facility?**

Electric power for the California Redwood Coast - Humboldt County Airport is provided via PG&E's Janes Creek 1103 distribution circuit. This power line comes along Airport Road and runs down Baadsgaard Avenue to provide electric power to the main airport terminal and numerous adjacent facilities, including the U.S. Coast Guard Sector Humboldt Bay Air Station, the Humboldt Trap and Skeet Club, the Humboldt County Animal Shelter, and several other airport facilities (see Figure 1). The Redwood Coast Airport Renewable Energy Microgrid will be located at the end of the Janes Creek 1103 distribution circuit and will serve the facilities noted above.

The Airport Microgrid will begin on Baadsgaard Ave., where an automatic switch will be installed. When grid power is lost, the switch will open in order to isolate the microgrid from the larger electric grid. The battery energy storage system will then energize the microgrid circuit and provide power to all facilities on the circuit. If the sun is shining, the solar electric systems will provide power as well. Because of the large size of the battery and solar electric systems relative to the loads on the microgrid circuit, it is expected that they will be able to provide adequate power for extended periods. In the unlikely event the batteries become too far discharged, existing backup diesel generators will come on-line to power the critical airport circuits and the Coast Guard air station.

Figures 2 and 3 illustrate the existing power system serving the airport. Figure 2 shows the existing system under normal conditions. Green lines indicate the circuit is energized. In this case, power from the PG&E grid is serving all facilities. Figure 3 illustrates a PG&E grid power outage on the existing circuit. In this case the only facilities that receive power are the critical airport circuits and the Coast Guard air station, as these are the only facilities powered by existing backup diesel generators.

Figures 4 through 6 illustrate the new microgrid circuit. Added equipment on the new circuit will include two automated switches, two solar electric arrays, and a battery energy storage system. In Figure 4, the new microgrid circuit is shown under normal conditions, where both automated switches are closed. In this case the microgrid circuit is connected to the larger PG&E power grid, solar power from the net-metered array is credited to the aggregated airport accounts,<sup>1</sup> and power from the battery system and wholesale PV array is traded by RCEA on the California Independent System Operator (CAISO) wholesale market.

Figure 5 shows the new microgrid circuit in an islanded state, when the PG&E grid has lost power. In this case the solar electric arrays and batteries power all facilities on the microgrid circuit. Finally, in Figure 6, following a PG&E grid outage the batteries have become too depleted to power the microgrid circuit and have been disconnected. In this rare situation, the existing back-up diesel generators are called upon to provide power to critical loads until either the batteries can be recharged from solar power or grid power is returned.

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<sup>1</sup> See Attachment A for a discussion of aggregate net metering.





- Airport microgrid boundary
- PG&E Janes Creek 1103 distribution circuit

**Figure 1: Outline of Redwood Coast Airport Renewable Energy Microgrid**

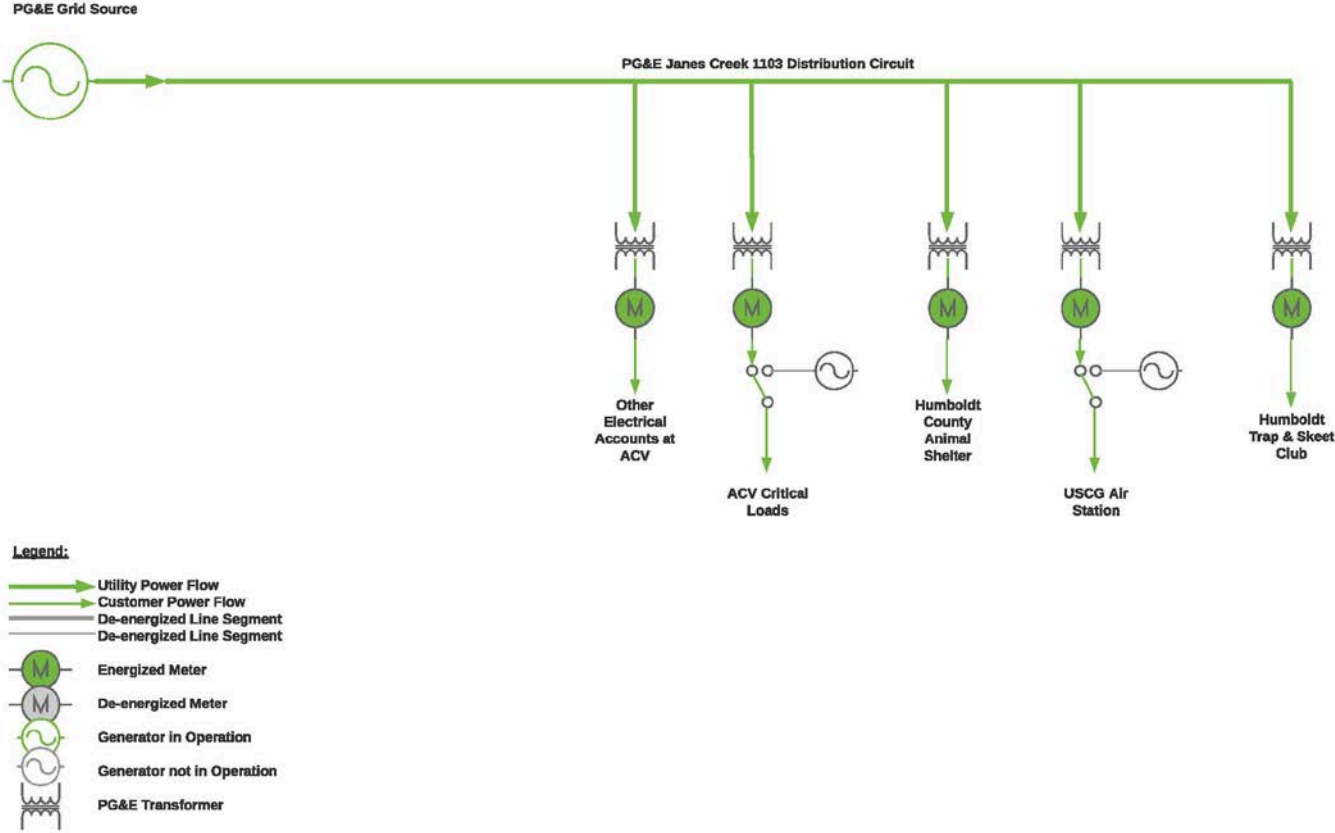


Figure 2: Existing Janes Creek 1103 distribution circuit, normal conditions

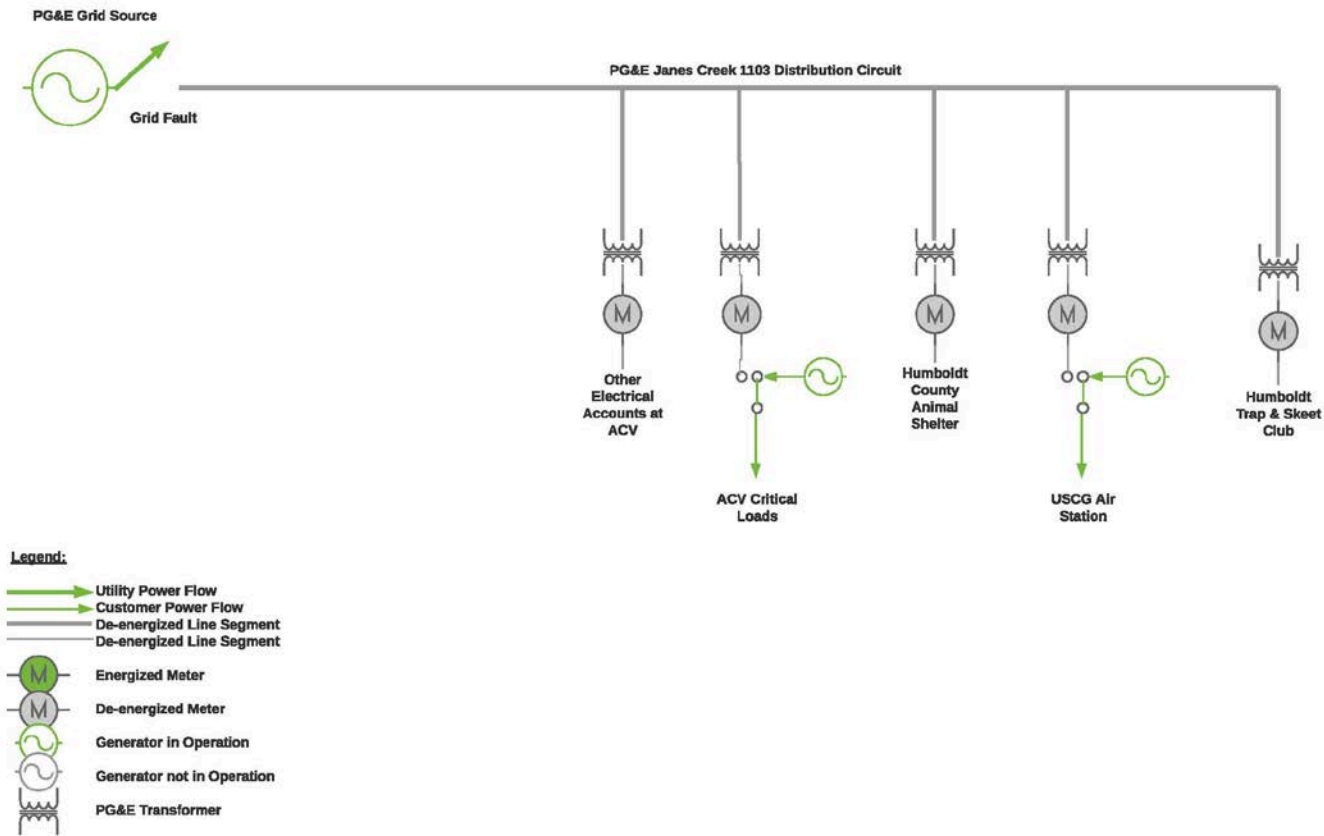


Figure 3: Existing Janes Creek 1103 distribution circuit, PG&E grid outage

Note: During normal grid connected operations the RCEA Wholesale Generation System will produce power for local Community Choice Energy customers (93% of Humboldt County's electricity consumers including the airport) using the California Independent System Operator Wholesale Market as a transaction framework.

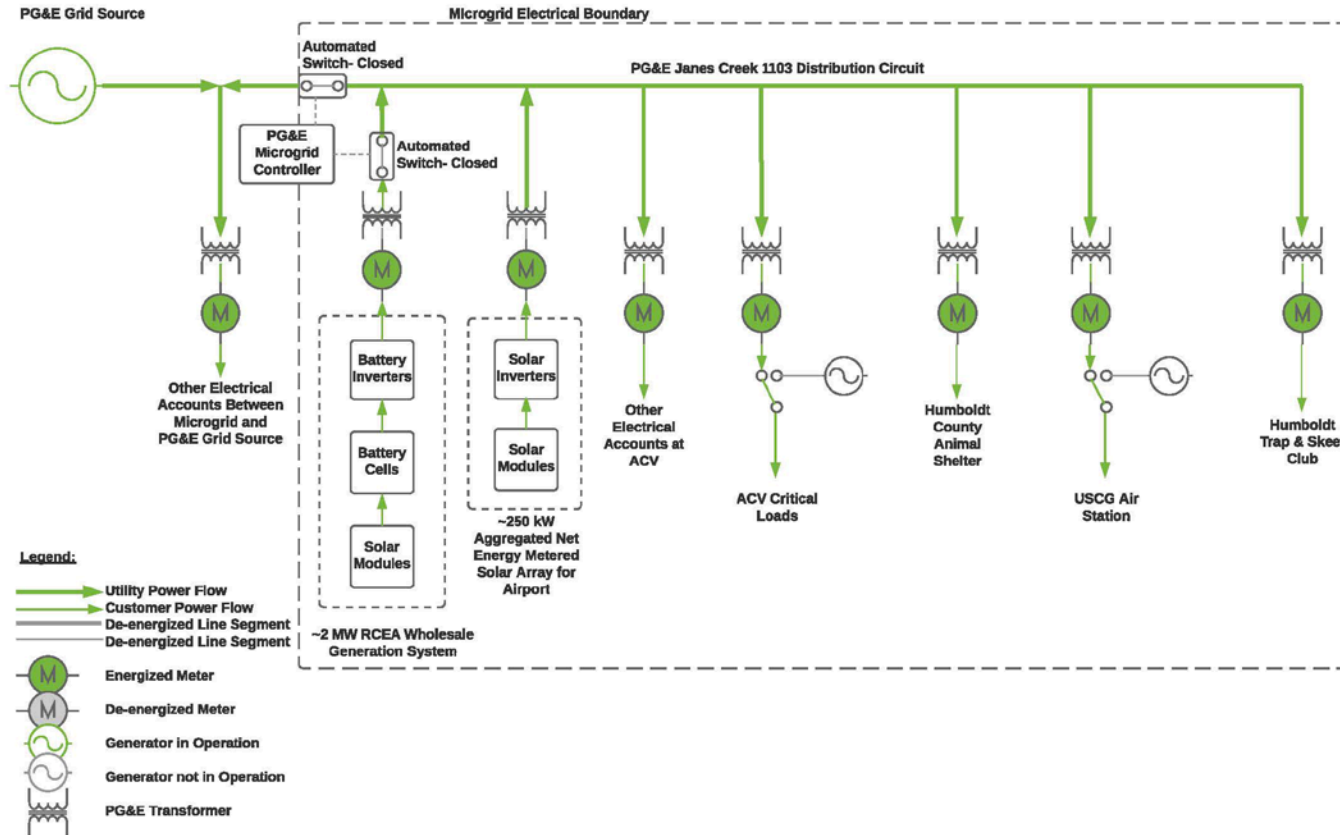


Figure 4: Janes Creek 1103 circuit with microgrid, normal conditions

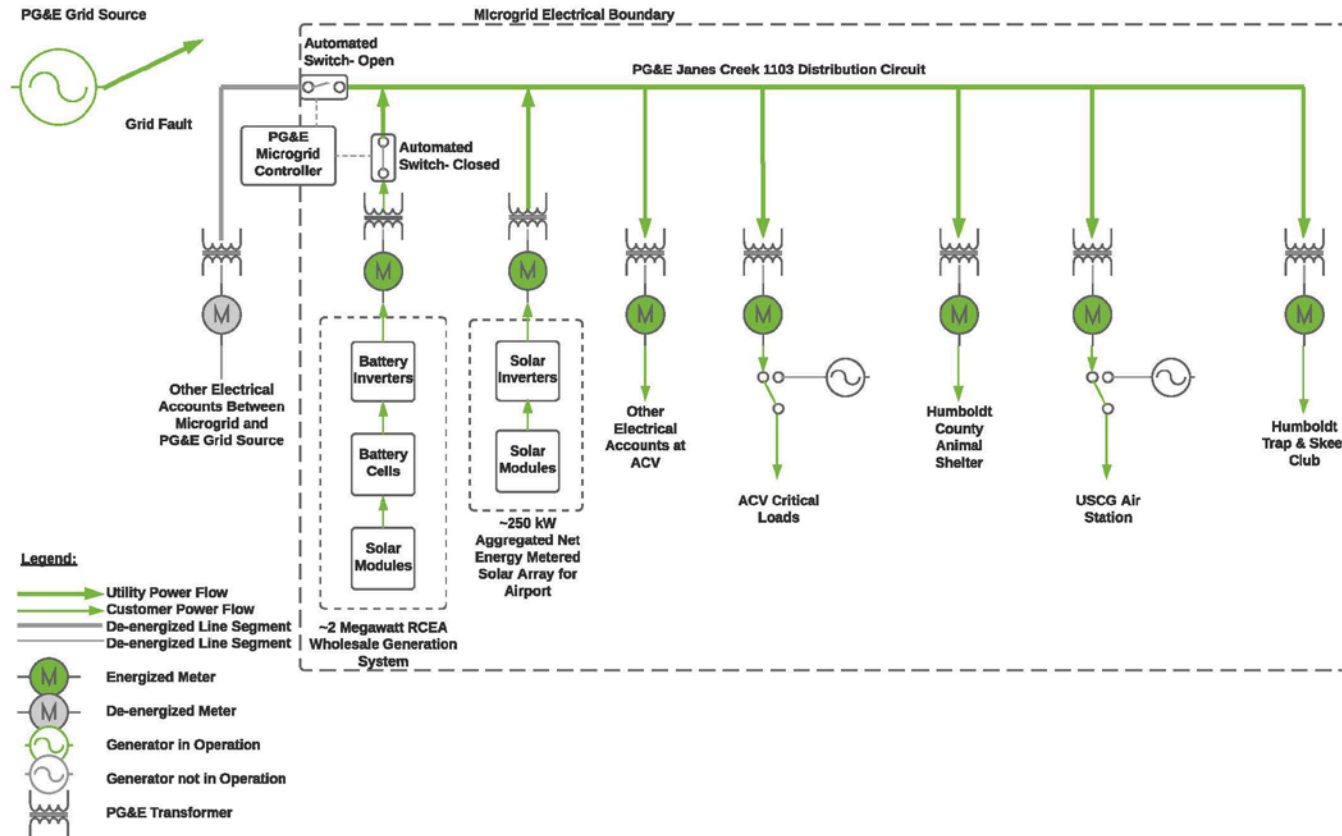


Figure 5: Janes Creek 1103 circuit with microgrid, islanded state on microgrid power

PLANNED CONFIGURATION- MICROGRID- ISLANDED- BATTERY DEPLETED

SERC | November 8, 2018

**Note:** Due to the relatively large size of the RCEA Wholesale Generation System compared to the loads within the microgrid electrical boundary, the battery will not typically be depleted enough for the microgrid to reach this state during an inslanding event.

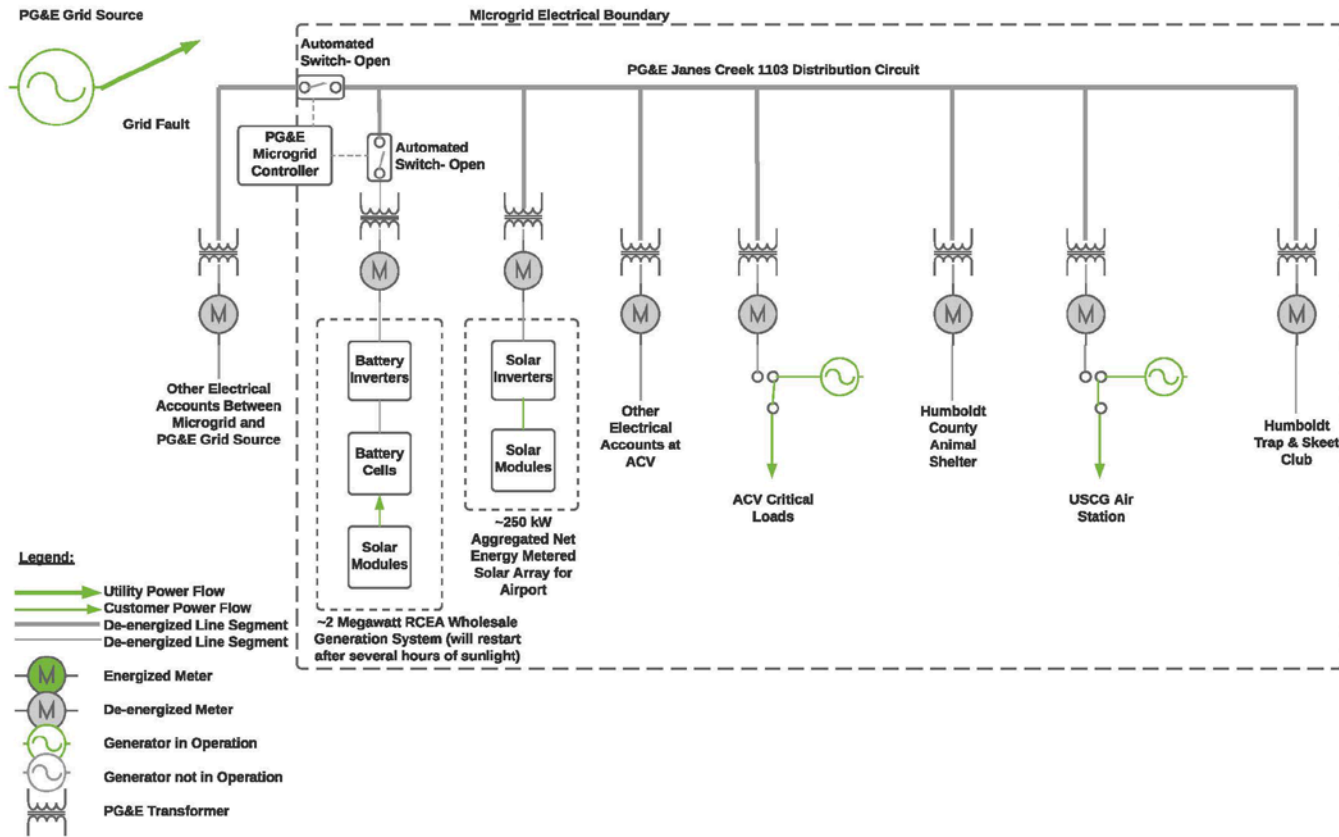


Figure 6: Janes Creek 1103 circuit with microgrid, islanded state on back-up generator power