HAWAII ENERGY CONNECTION®
sustainable energy solutions

Planning for
Enphase Ensemble™ Energy Storage

This document includes essential information surrounding the Proper Evaluation, Design, and Installation Planning for the Enphase Ensemble™ Energy Storage System. As Energy Storage System technologies rapidly evolve, maintaining realistic expectations of their benefits and limitations become more and more important. A detailed understanding of the information below will help insure that our customers, sales consultants, planning and installation teams each have a common understanding of the achievable outcome.

Please Note; Diagrams and other information within this document are examples only and may not be relevant in your specific situation. For example some of the general information below may not reflect local electrical code requirements, City & County plan reviewer or electrical inspector interpretation of National Electric Code requirements.

As renewable energy solutions become more powerful they can also seem more complex and sometimes overwhelming. You can take comfort that Hawaii Energy Connection / KumuKit™ remains dedicated to delivering easy to understand solutions, optimum design, planning, installations and achievable benefit outcomes for all of our Customers.

Regulatory Background – National Electrical Code (NEC)

Grid-tied-only PV inverters are required to shut down in the event of a utility grid power outage. They cannot form an un-intentional island (be energized when the grid is down) and their anti-islanding technology prevents the formation of un-intentional islands for safety of utility workers. Ensemble technology systems do not have the same restrictions and could provide backup to some or all of the load circuits in a home by intentionally islanding according to the latest National Electric Codes. The Enpower smart switch with built in transfer switch functionality, works in conjunction with the multimode inverters in the Encharge energy storage system to form a microgrid system that intentionally islands away from the local electric power system.

Economic Use Cases

There are many economic goals that the Encharge storage system supports. These include bill reduction, demand charge reduction, and energy arbitrage. A special case of Self Consumption, called power export limiting, is supported for applications where the utility does not allow a homeowner to export power from the PV system to the grid. One example is the Hawaii self-supply and NEM+ programs where no export is allowed, which is called zero export.

Optimizing energy storage capacity sizing for each specific economic use case is beyond the scope of this document. Hawaii Energy Connection representatives have sophisticated system size calculators that can be used to assist with sizing these various use cases.

Main components of the Ensemble Energy Storage System

The Enphase **Encharge-10** storage system units are reliable, smart, simple, and safe. They provide the lowest lifetime energy costs with backup for both new and retrofit solar customers.

Each Encharge-10 has a total usable energy capacity of 10.08 kWh and twelve embedded grid-forming microinverters with 3.84 kW power rating.

Lithium iron phosphate (LFP) chemistry for maximum safety and longevity.

The Enphase **Enpower smart switch** consolidates interconnection equipment into a single enclosure and streamlines grid-independent capabilities of PV and storage installations. Enpower is a microgrid interconnect device (MID), or transfer switch, that allows isolation between the backup battery system and the grid during a grid outage. It is required when designing a system for backup to some or all of the load circuits in a home.

The **wireless communication kit** enables direct communication between the Encharge storage system, the Enpower smart switch, and the IQ Envoy monitor. It uses 2.4 GHz and 915 MHz frequencies in parallel for maximum reliability. The kit is required when designing a system for backup to some or all of the load circuits in a home. .

Non-backup Configurations

A **non-backup configuration** using the Encharge storage system can be added to an existing system without using an Enpower smart switch, however, it will not provide backup. When installed in this configuration, Encharge storage system is treated as a distributed energy resource (DER) equivalent to a PV system and cannot island away from the utility.

In self consumption scenarios, a homeowner's PV system generation is stored in the Encharge storage system for use later in the day when there is not sufficient power from Solar PV to supply the home loads. Homeowners benefit by consuming and storing the onsite-generated energy themselves instead of exporting it to the grid during the day and purchasing power from the grid during evening and night times.

In customer self consumption scenarios, we size the Encharge storage system capacity to accommodate the expected daily energy export. This is roughly less than two thirds of the average daily energy load of the home.

Economic use case: This configuration does not provide backup power. Systems will typically use 1 to 2 Encharge-10 batteries and result in the lowest system cost and best economic payback. The energy storage component will be sized specifically for this purposes of maximum bill savings. This configuration does not provide backup capabilities in the case of a grid outage.

Backup Power Configurations

Ensemble technology system flexibility enables many backup configurations for different customer goals and needs. There are two common configurations that allow the Encharge storage system to provide power to customer loads independent of the grid.

Partial home (subpanel) backup is recommended when the customer desires basic load back up or when there are technical or monetary constraints that prevent whole home (main load panel) back up. This is achieved by installing Encharge storage systems with smaller energy and power capacities that are sized mostly for utility bill savings.

Economic use case: This configuration will typically use 2 to 3 Encharge-10 batteries, taking a balanced approach to costs and benefits, while still providing a favorable economic payback. In this configuration, the energy storage component may be sized slightly larger than what is required for a non-backup system and must include the Enpower smart switch for the backup operation of essential items in the case of a grid outage. This configuration is not intended for whole home backup.

WARNING: Under sizing power and energy capacity of the storage system may lead to a poor user experience. User education and setting reasonable expectations of system performance is essential with systems involving backup storage.

In a **whole home (main load panel) backup** configuration, the Enpower smart switch is installed between the electrical meter and main load panels rated up to 200A. This allows a properly sized Ensemble energy storage system to provide power to all loads in the main load panel in the event of a grid outage. We do not support customers going off grid with this technology.

NOTE: The configuration for whole home backup can be both complicated and expensive. Additional fees may apply if a 3rd party load analysis is required. There are many requirements and constraints that may prevent whole home backup on some homes.

According to National Electric Code requirements, power supply to a premises wiring systems shall be permitted to have less capacity than the calculated load, but the capacity of the stand-alone supply (Enchage storage system) shall be equal to or greater than the load posed by the largest single utilization equipment connected to the system. Calculated general lighting loads shall not be considered as a single load. Based on these types of requirements, we will need to work with the homeowner to perform an exhaustive load analysis of the home. Additional fees may apply if a 3rd party load analysis is required.

Economic use case: This configuration will typically use 3 to 4 Encharge-10 batteries and places a bias towards emergency backup operation and security during a grid outage, resulting in a less favorable economic payback. In this configuration, the energy storage component will be sized above what is required for non-backup and partial backup configurations. This system must include the Enpower smart switch for the backup operation of essential items in the case of a grid outage. While this configuration is intended for whole home backup, the homeowner will still want to limit energy consumption during a grid outage to extend battery operation.

WARNING: Under sizing power and energy capacity of the storage system may lead to a poor user experience. User education and setting reasonable expectations of system performance is essential with systems involving backup storage.

Sizing Encharge storage systems for backup operation

It is important to differentiate the terms **power** and **energy**. Power is a measure of the instantaneous electricity used and it is expressed in units of watts (W) or kilowatts (kW). Energy is the accumulated or integrated power used over time and it is expressed in units of watt-hours (Wh) or kilowatt-hours (kWh). When running in backup operation, any power shortages or energy capacity shortages will result in a loss of power to loads and should be avoided. Therefore, it is important to properly size the system for both power and energy capacities in each installation.

Power (kW) capacity for an Encharge storage system must exceed both the largest single load and 67% of the total power rating of IQ microinverters installed at the site (Table 1).

The basic goal is to sufficiently size the total Encharge storage system power rating to power loads and charge from PV power generation. You can increase the power rating by adding additional Encharge storage units, which also provide additional energy, improving the customer user experience.

Energy storage (kWh) capacity should be sized to supply the estimated backup loads for a user defined time period.

Table 1: Encharge storage system details for backup operation

Enharge 10 units	Largest maximum single load power rating (AMPs)	Largest maximum single load power rating (kWac)	Max IQ7+ PV microinverters (Ea.)	Max PV system power (kWac)	Encharge energy capacity (kWh)	Maximum hours of operation based on average 4 kWac power rating	Maximum hours of operation at maximum single load power rating
1x Encharge 10	16	3.8	19	5.76	10.0	2.5	2.6
2x Encharge 10	32	7.6	39	11.52	20.1	5.0	2.6
3x Encharge 10	48	11.5	59	17.28	30.2	7.5	2.6
4x Encharge 10	64	15.3	79	23.04	40.3	10.0	2.6

Step 1

Identify the largest maximum single load power rating (kW or AMPs) that is installed in the panel(s) to be backed up, and select the absolute minimum number of Encharge units required to meet the National Electric Code (NEC) requirements as outlined in Table 1.

Table 1: Encharge storage system details for backup operation-1

Enharge 10 units	Largest maximum single load power rating (AMPs)	Largest maximum single load power rating (kWac)	Max IQ7+ PV microinverters (Ea.)	Max PV system power (kWac)	Encharge energy capacity (kWh)	Maximum hours of operation based on average 4 kWac power rating	Maximum hours of operation at maximum single load power rating
1x Encharge 10	16	3.8	19	5.76	10.0	2.5	2.6
2x Encharge 10	32	7.6	39	11.52	20.1	5.0	2.6
3x Encharge 10	48	11.5	59	17.28	30.2	7.5	2.6
4x Encharge 10	64	15.3	79	23.04	40.3	10.0	2.6

Step 2

Based on the PV system size requirements from the Kumukit System Calculator, find the maximum continuous output power (AC) of the PV system. Then select the minimum number of Encharge storage units required so that the total Encharge storage system power capacity is equal to or greater than 67% of the PV system maximum continuous output power per Table 1. In other words, do not size systems where PV system maximum continuous output power is more than 150% of total Encharge storage system power capacity.

Table 1: Encharge storage system details for backup operation-2

Enharge 10 units	Largest maximum single load power rating (AMPs)	Largest maximum single load power rating (kWac)	Max IQ7+ PV microinverters (Ea.)	Max PV system power (kWac)	Encharge energy capacity (kWh)	Maximum hours of operation based on average 4 kWac power rating	Maximum hours of operation at maximum single load power rating
1x Encharge 10	16	3.8	19	5.76	10.0	2.5	2.6
2x Encharge 10	32	7.6	39	11.52	20.1	5.0	2.6
3x Encharge 10	48	11.5	59	17.28	30.2	7.5	2.6
4x Encharge 10	64	15.3	79	23.04	40.3	10.0	2.6

Step 3

Based on the estimated backup loads for the user defined time period, calculate the required Encharge energy storage (kWh) capacity and the minimum number of Encharge storage units required.

Table 1: Encharge storage system details for backup operation-3

Enharge 10 units	Largest maximum single load power rating (AMPs)	Largest maximum single load power rating (kWac)	Max IQ7+ PV microinverters (Ea.)	Max PV system power (kWac)	Encharge energy capacity (kWh)	Maximum hours of operation based on average 4 kWac power rating	Maximum hours of operation at maximum single load power rating
1x Encharge 10	16	3.8	19	5.76	10.0	2.5	2.6
2x Encharge 10	32	7.6	39	11.52	20.1	5.0	2.6
3x Encharge 10	48	11.5	59	17.28	30.2	7.5	2.6
4x Encharge 10	64	15.3	79	23.04	40.3	10.0	2.6

Step 4

Based on a site's load analysis of both power (kW) and energy capacity (kWh) requirements, determine the total number of Encharge units necessary for the storage system to have sufficient capacity.

a) The minimum number of Encharge-10 units required is the largest of the calculated values in steps 1 and 2.

b) The desired number of Encharge-10 storage system units is the value calculated in step 3.

c) The maximum allowed number of Encharge-10 units that can be connected to an Enpower smart switch is four.

Table 1: Encharge storage system

Enharge 10 units	Encharge energy capacity (kWh)
1x Encharge 10	10.0
2x Encharge 10	20.1
3x Encharge 10	30.2
4x Encharge 10	40.3