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EPISODE 42

Off-grid Energy Storage with Solis

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Off-grid Energy Storage with Solis

>> Background

For areas without power grids or frequent power outages, such as remote rural areas, edge of grid locations, ocean island arcs, mountain areas, etc., off-grid energy storage systems bring great benefits. Some homeowners are now also choosing to go “off-grid” in order to be less reliant on their local power grids. Power cuts due to extreme weather conditions and the rising global cost of energy is prompting consumers to rethink how they power their homes.

Solis provides complete solar power solutions for this type of demand and different application scenarios. From small pure off-grid systems and self-consumption energy storage systems, to oil generator compatible systems, users can choose the corresponding solution to meet their specific needs.

This Solis seminar will demonstrate the off-grid energy storage system using Solis Off Grid products.

>> About Solis Off-grid Inverters (EO series)

The Solis EO series off grid inverter is integrated with 1 MPPT solar charge controller with a wide voltage range (90~480V) to adapt to many system design needs and maximise generation. It can support the connection of mains and diesel generators, and for larger systems up to 10 inverters can be connected together in parallel.

Exquisite design appearance and compact structure make installation more convenient for system owners. Featuring multiple integrated safety features and protection measures as well as online system monitoring. This online monitoring ensures the safety of batteries and all other connected equipment by enabling fast, efficient identification of any faults. Ongoing operation and maintenance of a Solis off grid system is simple, convenient and efficient.

Key Product Features

S5-E01P(4-5)K-48

- Enhance AC charger up to 80A and Solar charger up to 100A
- Built-in MPPT solar charge controller
- Wide MPPT voltage range (90~480V)
- Maximum PV input voltage up to 500VDC
- Small charging and discharging current ripple extends the battery lifetime
- Several work modes via simple LCD display
- Compatible with grid and/or generator power input
- Parallel operation up to 10 inverters (40-50KW)
- Works with or without batteries connected
- Built-in blue-tooth for mobile APP set up and monitoring
- Reserved external communication interface

Strong load-support capacity

Solis EO series off-grid inverters can carry various non-linear loads, up to 5KW, which can basically satisfy all kinds of household appliances.

Washing machine

Refrigerator

Vacuum Cleaner

Electric Fan

Hair Dryer

Designing Energy Storage Systems with Solis Off Grid EO Series Inverters

Below we take a simple household based in Plymouth, UK as an example to describe the design of an off-grid system.

Step 1: Determine the load and energy consumption of the house

Table 1: Household energy consumption

Rooms	Devices	Rated power(W)	Quantity	Hours used per day(h/day)	Wh/day
Living Room	TV	100	1	2	200
	Computer	200	1	6	1200
	light	30	2	7	420
Kitchen	kettle	2200	1	0.5	1100
	microwave	2200	1	0.5	1100
	toaster	1000	1	1	1000
	refrigerator+freezer	100	1	24	1200
	light	28	1	2	48
Other	laptop	70	2	3	420
	WiFi	50	1	24	1200
	Air Conditioner	1000	1	3	3000
Bathroom	light	20	1	1	20
	washing machine	260	1	1	260
	fan	7	1	1	7
TOTAL		**7265**			**11175**

data is the first step thawhat will determine if your system is sound and economical. Understanding the energy consumption is critical when designing any solar + storage system – off grid or on grid.

Step 2: Calculate the number of solar panels needed for your location and average weather conditionstime of year.

Taking the UK as an example, AVERAGE PEAK SUN HOURS in Plymouth is 3.0 hours

Cities	Average Daily Peak Sun Hours (kWh/m2)
Southampton	2.9
Plymouth	3.0
Oxford	2.7
New Castle Upon Tyne	2.5
Manchester	2.5
London	2.8
Liverpool	2.6
Leicester	2.5
Kingston Upon Hull	2.5
Glasgow	2.4

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Figure1: average peak sun hours in the UK

> Calculate energy generation requirement:
> 11175Wh/day ÷ 3.0 sun hours/day = 32725W
> 32725W ÷ 0.8 (system losses) =4656.25W per day
> 4656.25W x 30 days Wh = 139,687.5 Watt-hours (139.6875 kWh/month)

This project will be dealing with lower voltage devices therefore a 48V system is suitable.

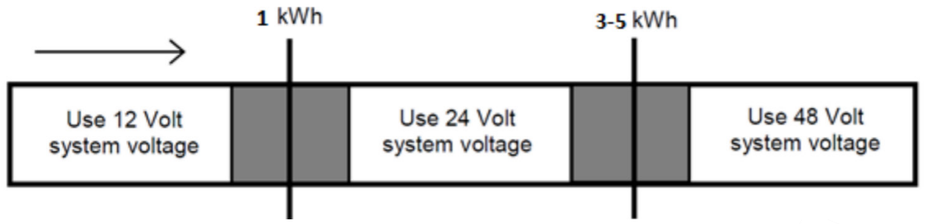

Figure 2: Variations of System Voltage with the Daily Demand

> Calculate Wattage and number of solar panels required:
> 11175Wh/day ÷ 3 sun hours/day = 32725W
> 32725W ÷ 0.8 (system losses) =4656.25W
> 4656.25/500 = 9.3125(3 Solar panels 500watts)

For this project we would use 10 solar panels @ 500 Watts each.

Step 3: Select the most appropriate Solis Off Grid Inverter Model

According to the calculated value, the photovoltaic panel capacity is 4656.25W, so the 4kW (S5-E01P4K-48) inverter is the correct model to select.

Technical Specifications

S5-E01P4K-48 | S5-E01P4K-48-P | S5-E01P5K-48 | S5-E01P5K-48-P

Parallel capability	Parallel capability:	NO		
Battery	Battery Type:	Li-ion/Lead-acid	Battery Voltage range:	48 V
	Maximum Charge/discharge current:	100 A	Communication:	CAN/RS485
Inverter Output	Rated output power:	4 kVA / 4 kW	Rated output voltage:	230 V ± 1%
	Rated frequency:	50 Hz / 60 Hz ± 0.1%	Surge capacity:	8 kVA
	Output voltage waveform:	Pure sine wave	Transfer time:	10 ms typical, 20 ms Max
	THDv (@linear load):	<3%	Peak efficiency (PV-AC):	96.7%
Solar Charger	Solar chager type:	MPPT	Recommended max. PV power:	5 kW
	Max. input voltage:	500 V	MPPT voltage range:	90-480 V
	MPPT number / Max. input strings number:	1/2	Max. solar charge current:	100 A
AC Charger	Rated input voltage:	230 V	Selectable voltage range:	90-280 V
	AC frequnence range:	50 Hz / 60 Hz (Auto sensing)	Max. AC charge current:	60 A

Figure 3: Main parameters of S5-E01P4K-48 inverter

Step 4: Select compatible batteries for the system according to load and energy consumption

$$\text{Battery Capacity (Ah)} = \left(\frac{(Total\ Watt{-}hours\ per\ day\ used\ by\ appliances}{Inverter\ \eta \times Nominal\ Battery\ Voltage(V) \times DOD(\%)} \times DOA\right)$$

The average daily energy consumption of the project is 11,175 (Wh/day) as previously shown in Table 1 above. If the Days of Autonomy (DOA) is 1 day, the inverter efficiency is 95%, the selected battery is a 48V lithium battery, and the Maximum Depth of Discharge is 80%;

> Battery Capacity (Ah)
> = (11175/ (0.95x0.80x48)) x 1
> =306.35Ah
> 306.35Ah Battery Capacity required for the system

Step 5: Balance the System

Select the appropriate cables, circuit breakers and protection devices using the above configuration to connect the entire system.

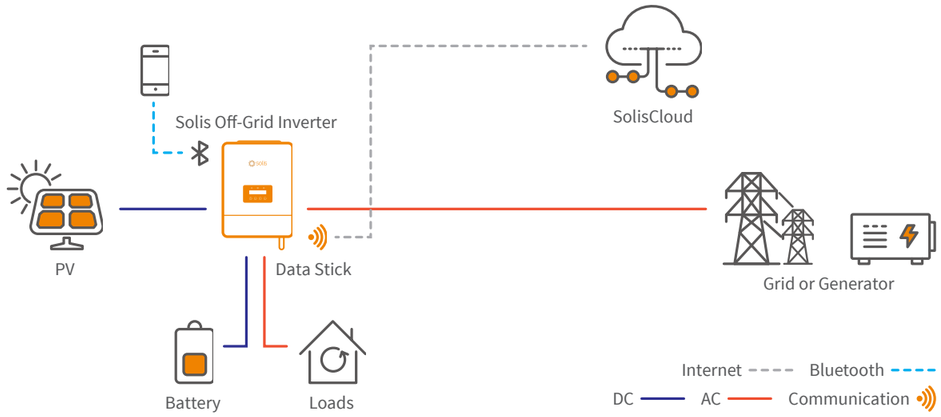

Figure 4: System topology

Summary

>> Off Grid systems can provide independence from the power grid and energy security for those in areas where there is no power grid. Critical to a successful and efficient system is to design and configure every element correctly. The energy consumed at the property is the starting point when designing a new off grid solar system.

The Solis off grid inverter series is adaptable to the needs of many usage scenarios – with storage, integrated with a generator etc.

For more information contact your local Solis team and visit www.solisinverters.com