Sizing charge controllers

Array capacity in Short Circuit Amps

With MPPT charge controllers amp capacity is on the

battery side

Plan for expansion if
needed (it is always prudent)

Size disconnects
Appropriately for array
Size conductors Appropriately for array &
Charge controller

Overcurrent =125% + 125% on PV side

Conductors = Maximum capacity
Of array and controller

Sizing Inverters:

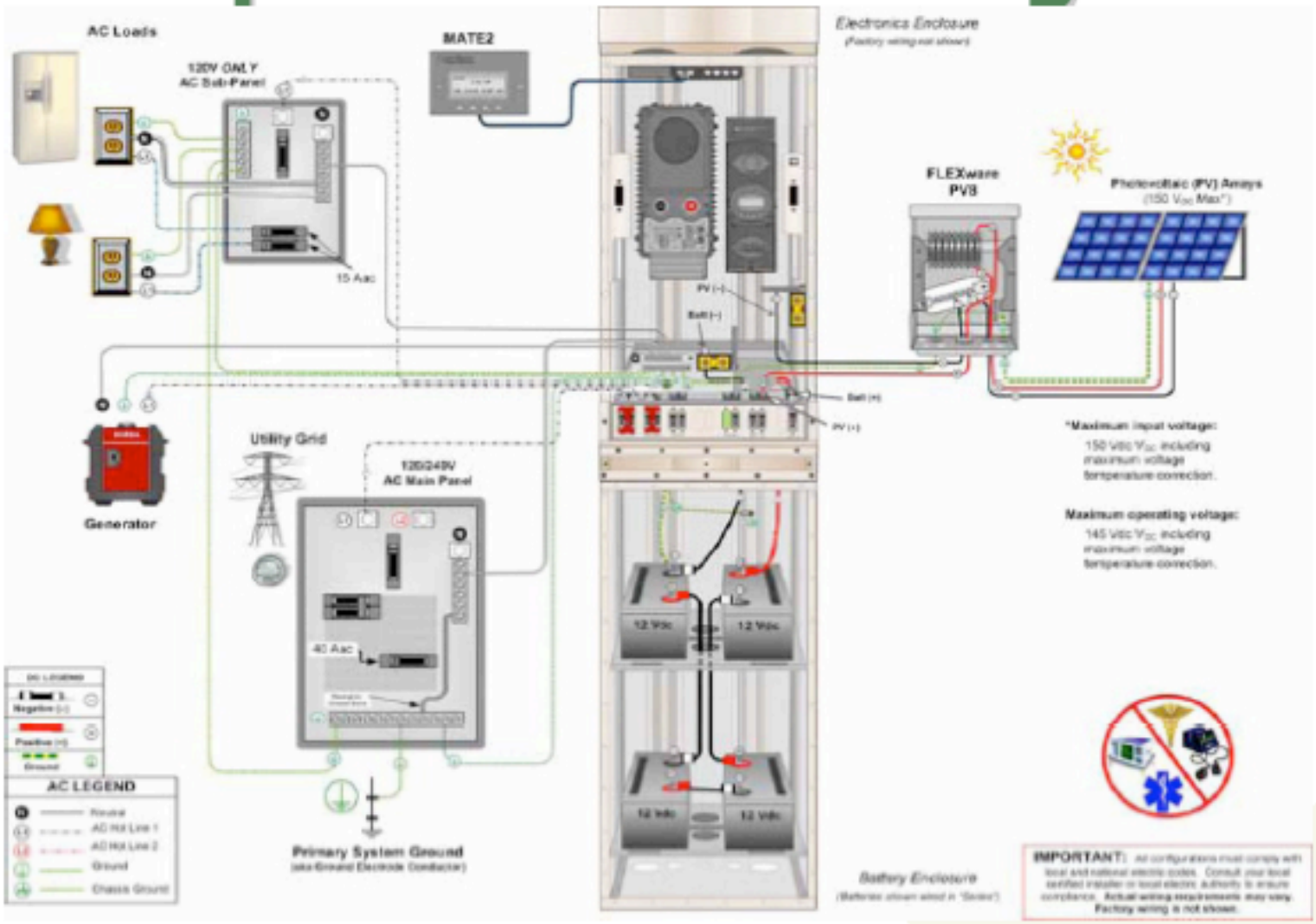
Off grid – Maximum load, Maximum Surge

Grid-tied with battery backup – Maximum load, surge in critical load profile
and
Array capacity…

Choose the correct output voltage –
120
120/240 stacked
120/240 single

120 with boosting Transformer…

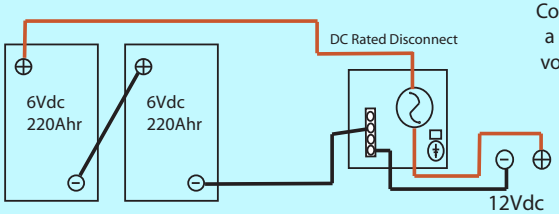
Simplified Install Diagram



OutBack Power Systems

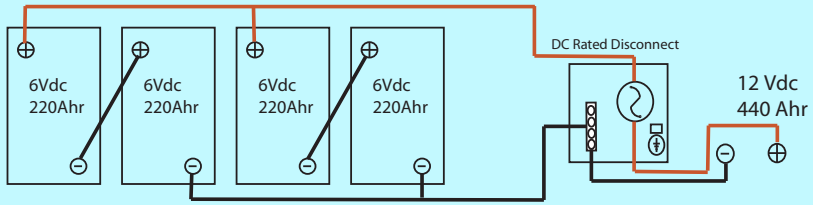
System Diagram Exercises: Page 3
Complete the diagrams to create a battery bank of the correct voltage and Amp hour capicty

#6



= Overcurrent disconnecting means

#7



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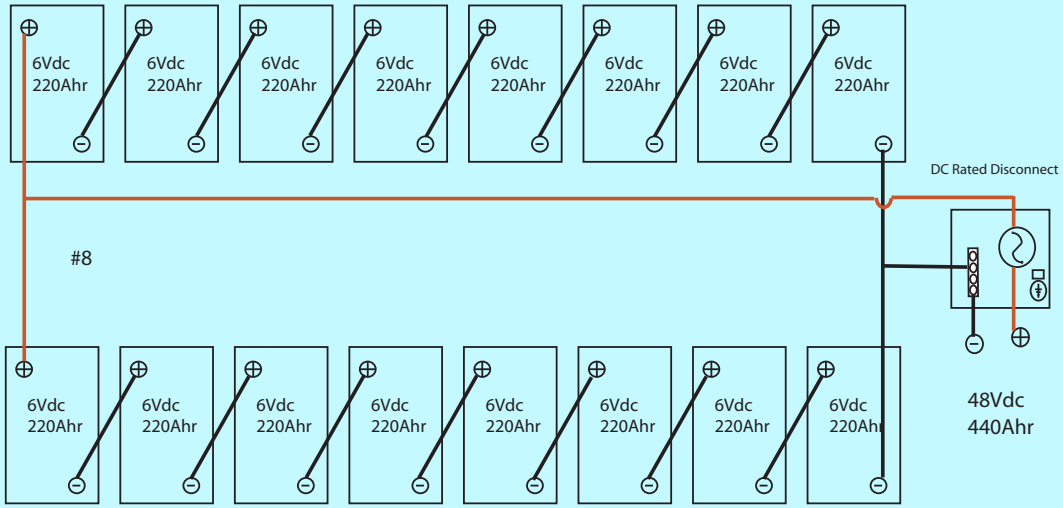
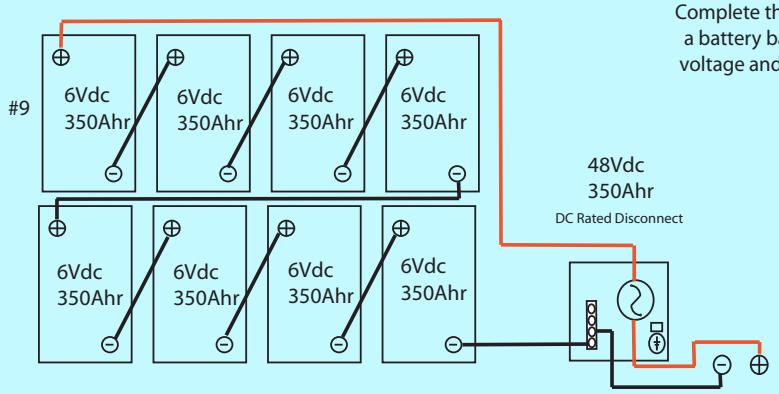
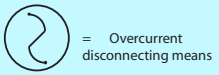
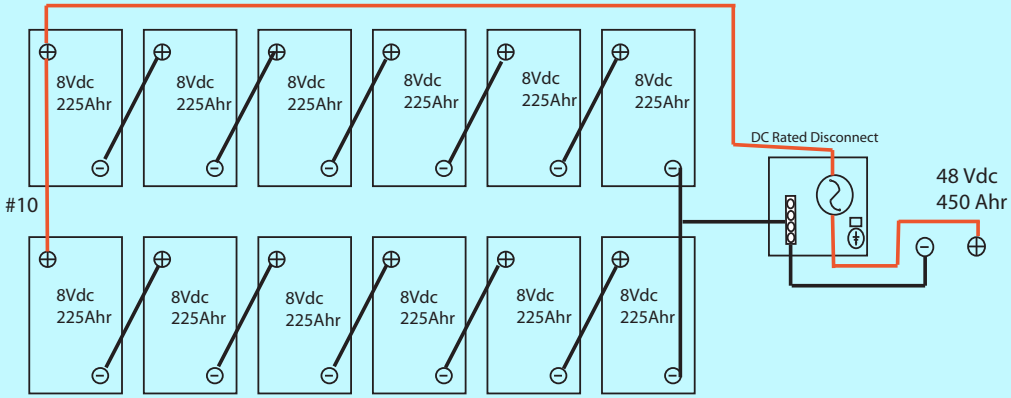


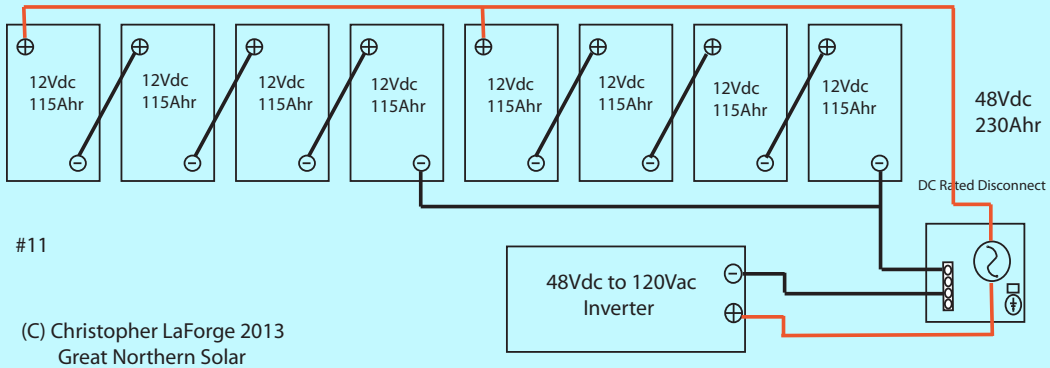
System Diagram Exercises: Page 4
Complete the diagrams to create a battery bank of the correct voltage and Amp hour capicty







Add in the Inverter...

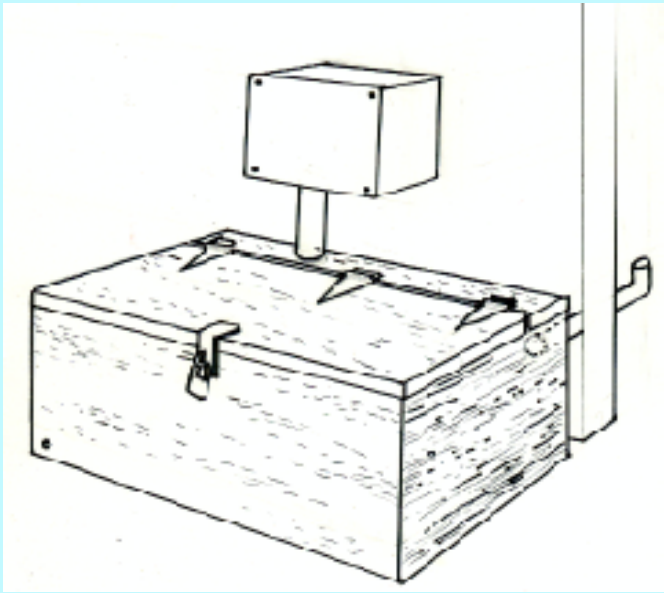


Battery Containment

For safe operation of systems with batteries an acid resistant battery containment (battery box) or battery room must be employed. Either type of containment must be vented to outside free air so that hydrogen sulfide gas and oxygen (an explosive mixture) are not allowed to build up in the battery containment. Ventilation can be active or passive but must allow the gasses to escape to the outside of the building. The containment must be acid resistant and provide for controlling accidental acid spills. Local codes may also specify fire resistant walls or other items for battery containment and therefore should be consulted before installation of the battery component of the system.

Battery containment should be able to be secured so that unauthorized persons cannot access the battery. A lock on the battery box or battery room door should be provided for this purpose.

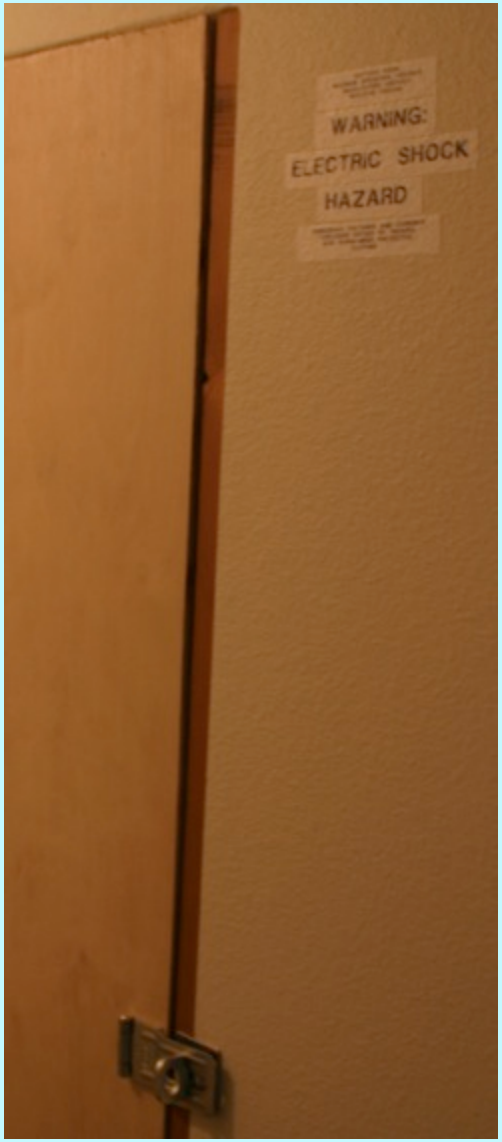
Battery use is safe and simple if basic safety rules are followed. Failing to do so presents serious and even fatal conditions for people unfamiliar with battery operation.



Commercial Battery Box Example - HDPE Plastic, available through most distribution…

Contains 8 – GC2 or L16 size batteries - 33” X 27” X 22.5”

Containment issues



Battery Room Safety Signage

My Safety Sign
www.mysafetysign.com

Enviroguard
www.enviroguard.com

Discussion:

Equipment choices –

- Charge controllers
- Batteries
- Inverters

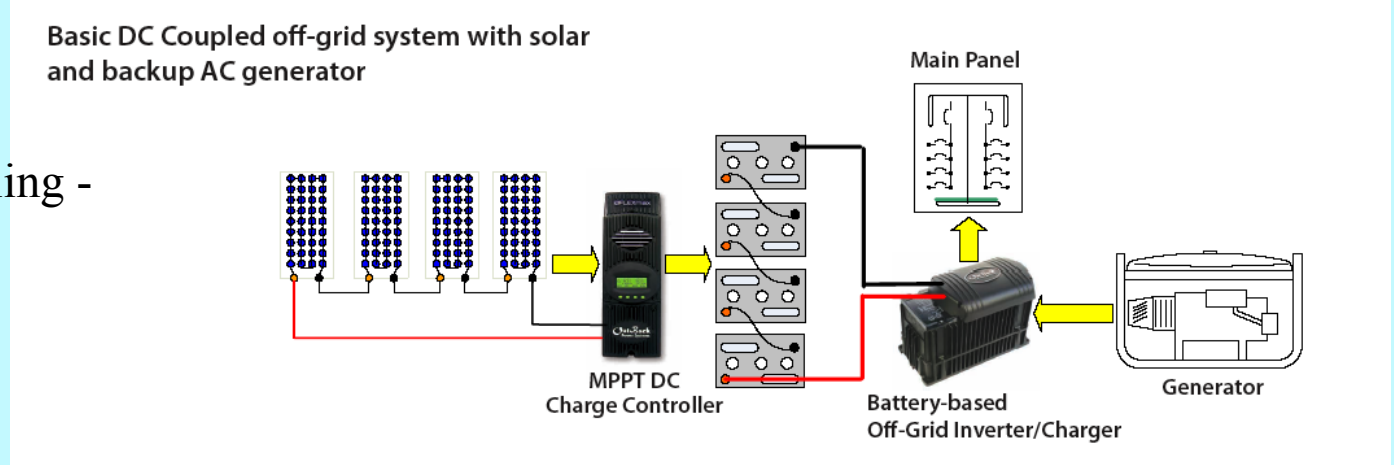
Schneider (formerly Xantrax) Offers the XW series for Battery based systems,

They also have other battery based equipment….

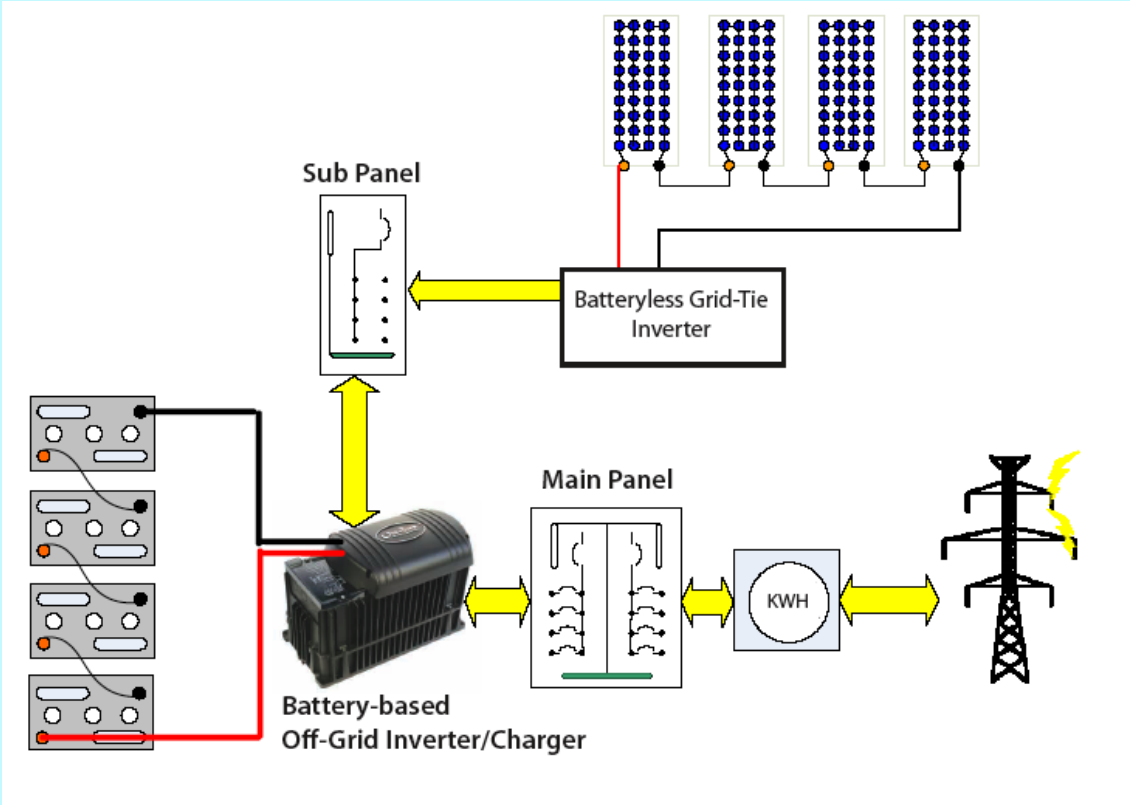
Grid intertie and Battery back-up and Straight grid intertie

Two system designs allow for backing-up the grid during power outages-

DC Coupling -



AC Coupling -



The First design is the traditional way to allow for backing-up the grid during power outages-

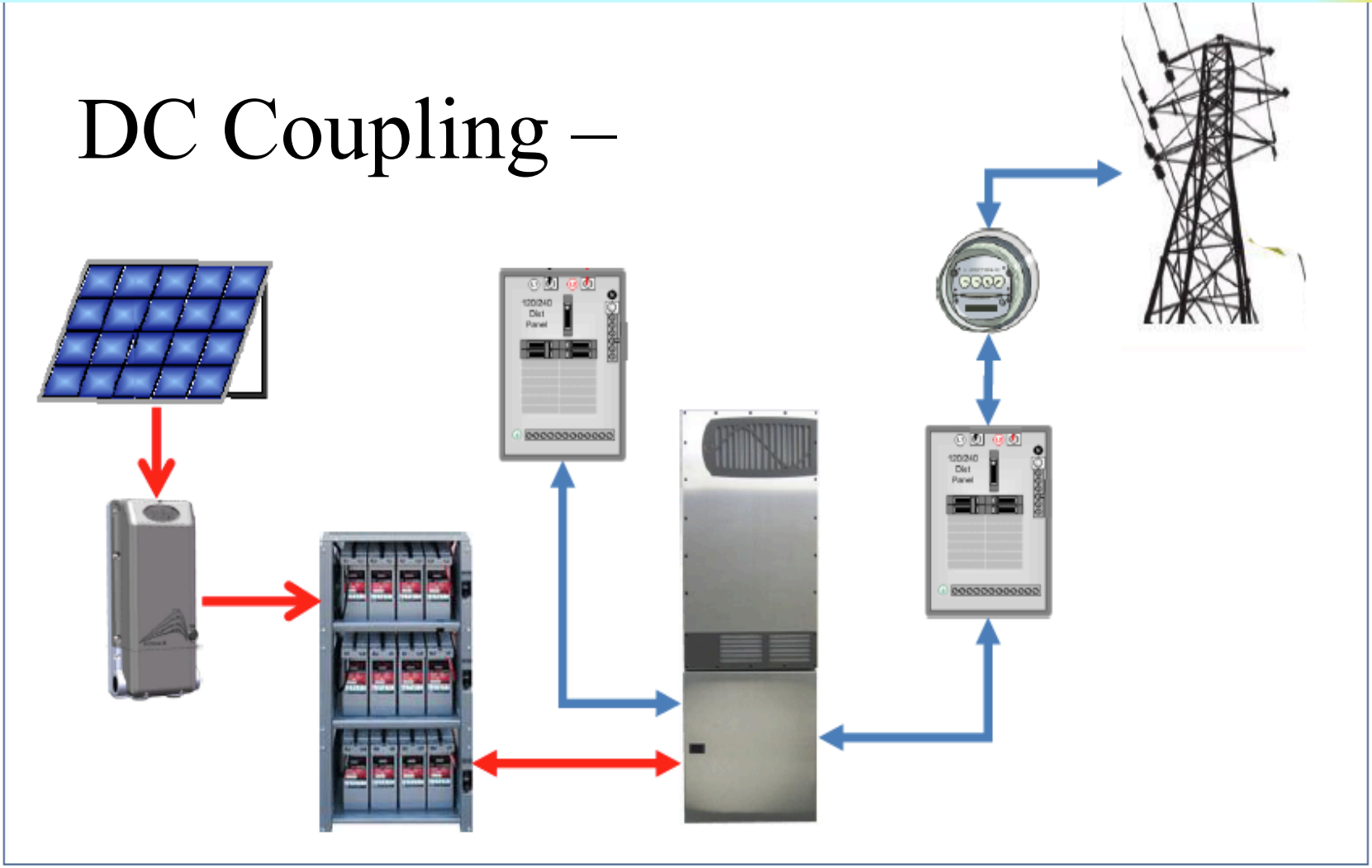
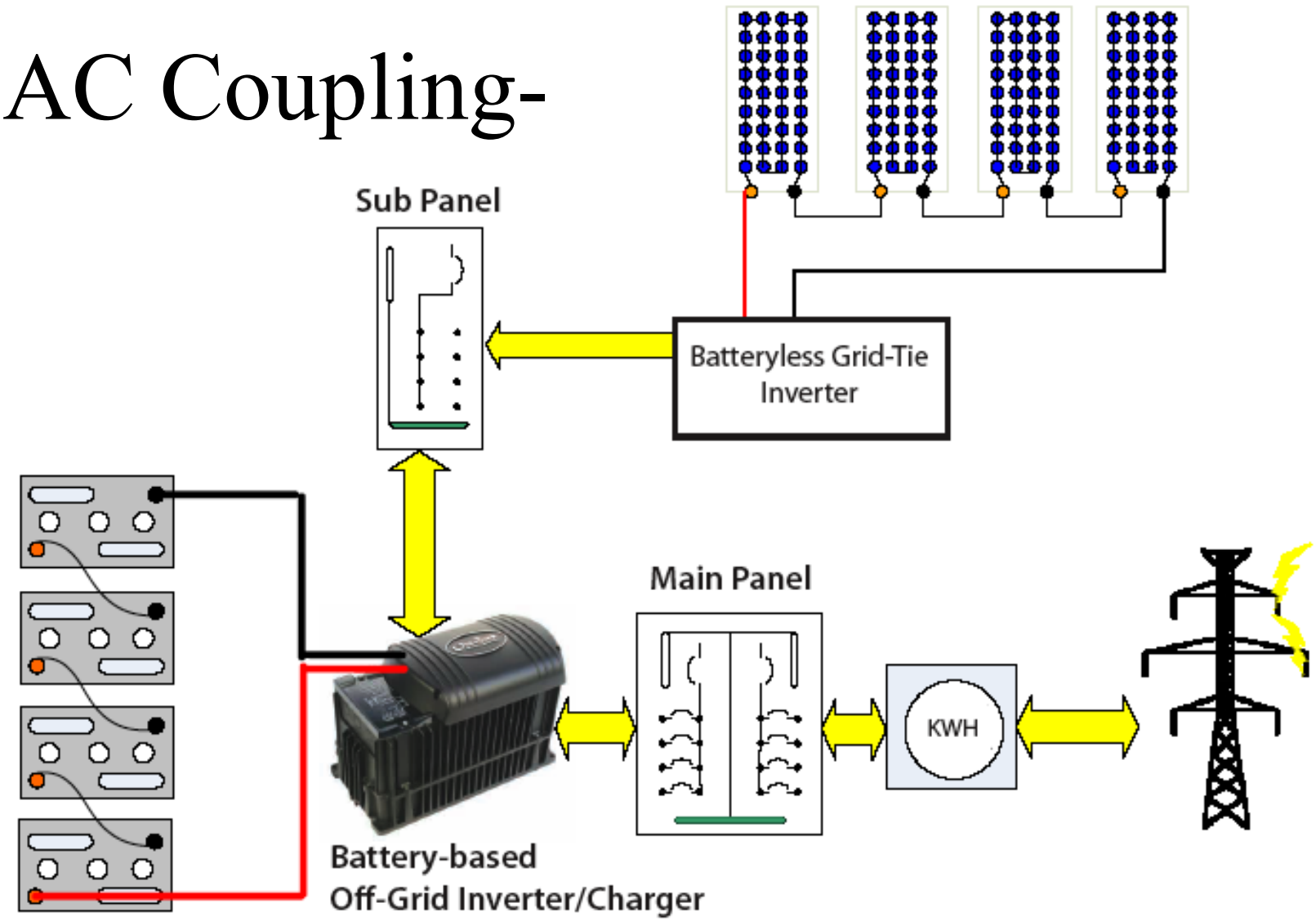


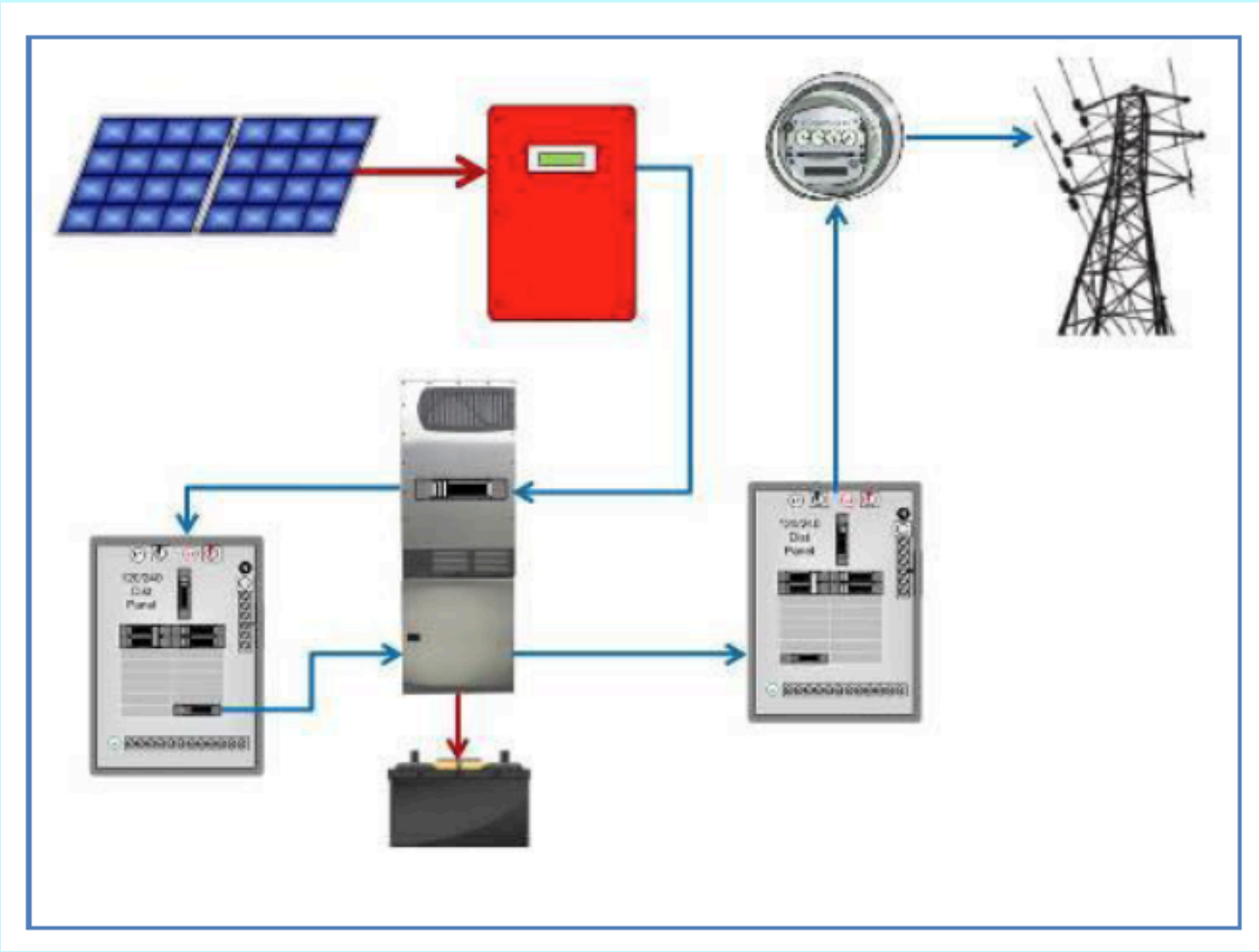
Figure 2 - Typical Grid/Hybrid System

The second design a newer way to allow for backing-up the grid during power outages. This allows battery-free systems to be retrofitted for battery back-up

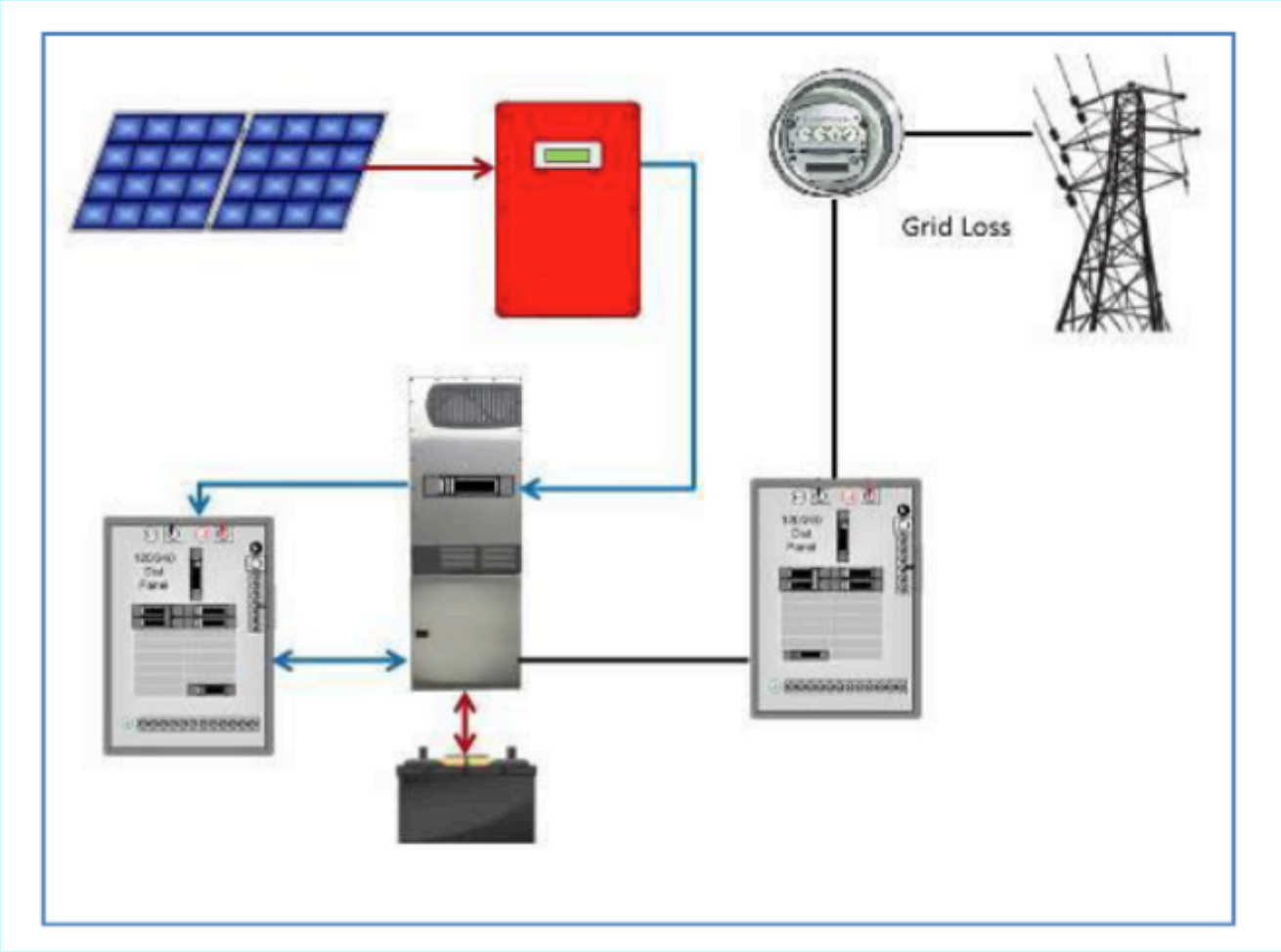
AC Coupling-



During normal grid-operation



During Grid power outages



SUNVERGE

DC –coupled design, LiOn Battery with Schneider BOS

The Choice for deploying at Hartley Nature Center – August 2016

Dashboard — Unit Details for HartleyNC01

Unit ID	Status	Control Mode
0e68b496-b87d-4e3b-8a09-81da463dcf38		

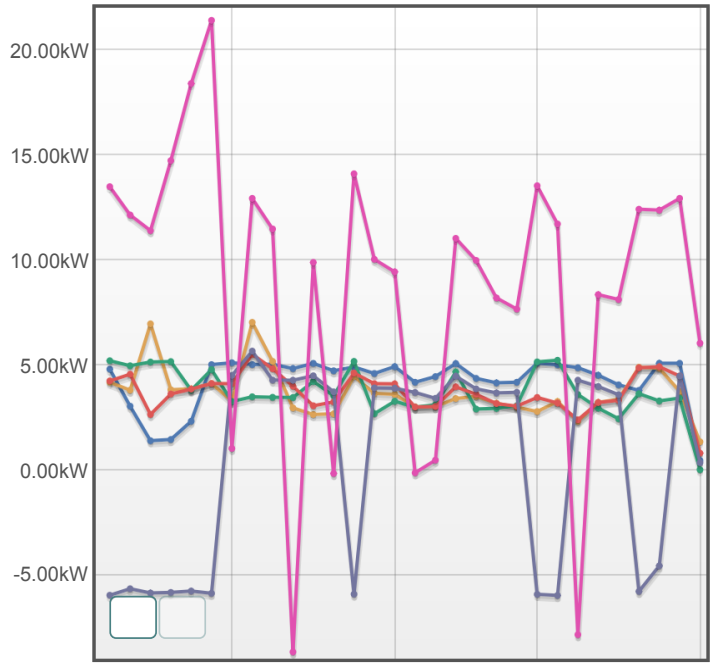
Overrides | Programs | Configure

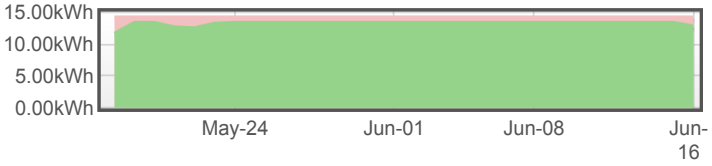
Operational View

View More

System Diagram | System Graph | Last Client Poll | Status Indicators

One Month Chart





	W	V	A	Hz	VA
PV DC	448.00	266.70	1.68		
Grid 1 In	255.00	122.04	3.60	59.97	391.00
Grid 2 In	171.00	121.36	2.13	59.97	247.00
Load 1 Out	271.00	121.88	2.76	0.00	336.39
Load 2 Out	176.00	121.88	1.70	0.00	187.70
Grid 1 Out	0.00	122.04	0.00	59.97	0.00
Grid 2 Out	0.00	121.36	0.00	59.97	0.00
Site Line 1	-39.00	121.84	1.76		214.37
Site Line 2	-836.00	121.84	7.04		911.36
Battery	340.00	55.90	6.10		

Capacity	14250.00	Wh
Stored	12540.00	Wh

Hartley Nature Center eGauge

View | LAN Access | Tools | Settings | Help

6/15/2017 7:26am – 6/16/2017 7:26am

Summary for time-period shown in graph

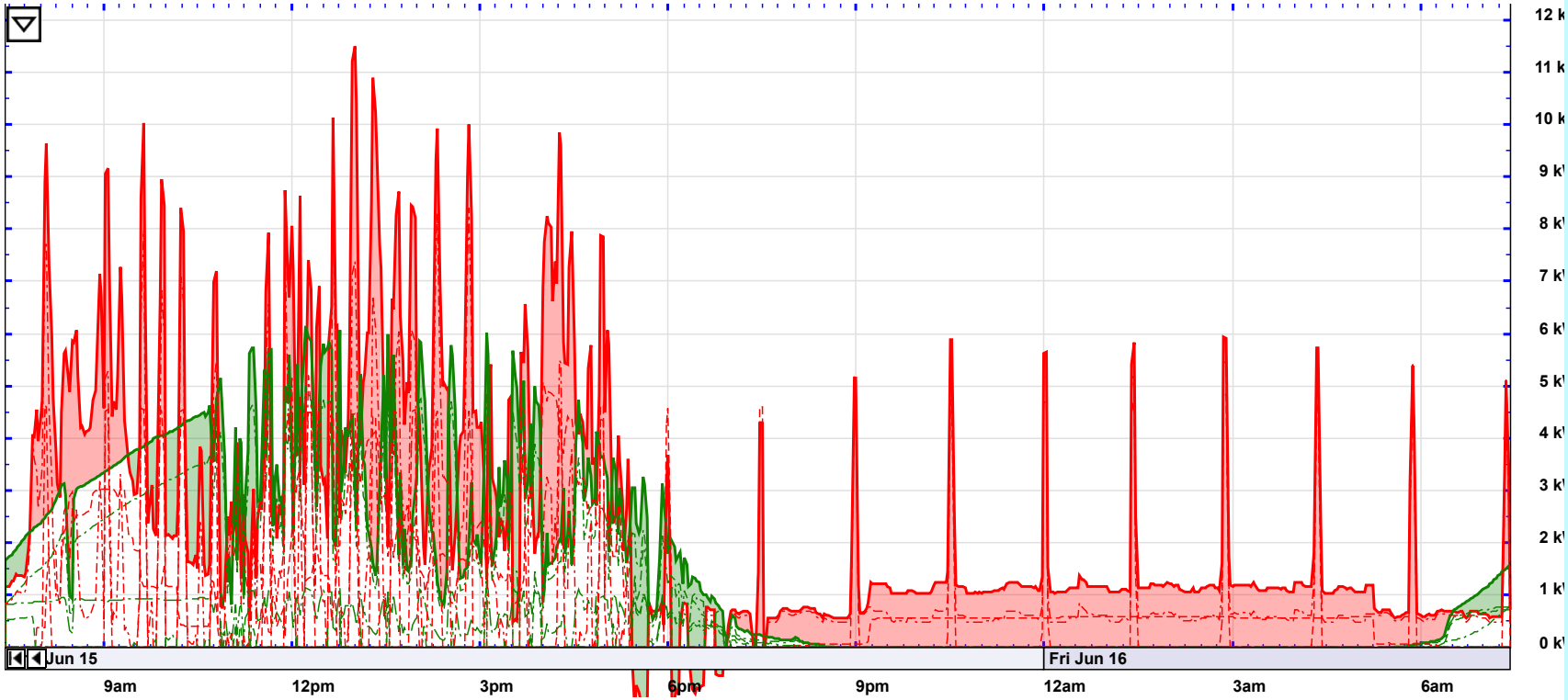
Energy Used	60.8 kWh	(approx. $7.90 used)
Energy Generated	37.1 kWh	(approx. $4.82 saved)
Net	23.7 kWh bought	(approx. $3.08 spent)

Summary over last 30 days

Energy Used	1.80 MWh	(approx. $234.47 u
Energy Generated	924 kWh	(approx. $120.17 s
Net	879 kWh bought	(approx. $114.30 s

All | 1y | 6M | 3M | 1M | 3w | 1w | 3d | 1d | 12h | 6h | 3h | 1h | 10m

Auto | 500kW | 100kW | 50kW | 10kW | 5kW | 1kW | 500W



☑ Power used	☑ Energy from grid	☑ Power generated	☑ Energy to grid
☐ Grid gen./use	☑ GSHP gen./use	☑ Electric Boiler gen./use	☑ Roof Solar gen./use
☐ Roof Solar+ gen./use	☑ Solar Tracker gen./use	☑ Electric Water Heater gen./use	☐ ERV1 gen./use
☐ ERV2 gen./use	☐ ERV3 gen./use	☑ LP1 Main gen./use	☑ LP2 Main gen./use
☐ Toggle all/none			

sonnen

"You can get easily to 60-70% of the cost [of a Sonnen system] through TOU arbitrage over the lifetime," he said, "and then if you add tax credits and all, you can achieve a breakeven, even if you are on net metering and time of use in those markets."

AC –coupled design,
LiOn Battery

AC Coupling Issues:

AC coupling combines batteryless and battery-based inverter/chargers in the same off-grid or grid-tied system, resulting in a system that is more easily upgraded and expanded than a DC coupled system. AC coupling accommodates multiple charging sources on the AC side of the system and does not require a charge controller to regulate DC power. For some applications, AC coupling has advantages over DC.

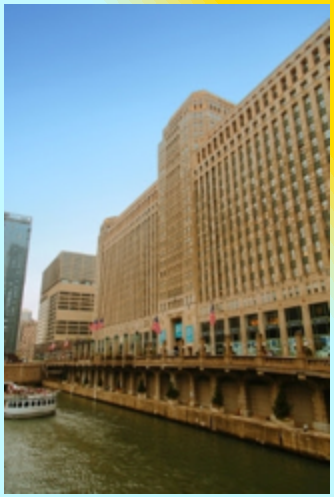
Although an AC coupled system requires the addition of a battery-based inverter/charger, some of this cost is offset by smaller conductor sizes and the absence of a DC charge controller.

Not every system design–for instance, small off-grid applications–will benefit from AC coupling. Those that will benefit include:

- A system whose solar panels, wind turbine, or other power generation source are a long distance from the loads it's powering
- Large grid-tie system owners wanting battery back-up not proportional to their power generating source (i.e. a 4 kW PV array with a 2 kW battery system)
- Multiple buildings and power generating locations off-grid
- Retrofitting battery back-up to an existing grid-tie system

Commercial/Industrial Systems:

Johnson Controls is a strong player in a busy field of energy-storage system vendors that includes other large players such as ABB, Tesla and Bosch competing with an array of startups in the commercial and industrial market, such as Stem, AMS, Geli and Greensmith.



Johnson Controls is offering its lithium-ion batteries that range from 500 kilowatts to 2 megawatts for large commercial and industrial customers, as well as 50-kilowatt to 250-kilowatt systems for commercial customers that want to put the energy storage systems within their building's electrical room.

One of Johnson Controls' first projects is in Chicago's Merchandise Mart, owned by Vornado Realty Trust. The 4.2-million-square-foot building was already using Johnson Controls for demand response.

With energy storage, the building can now play in PJM's frequency regulation market. The expanded platform will provide the storage capabilities enabling the Mart to participate in advanced fast response programs that adjust demand to changing conditions on the electric grid. Such active load Management strategies, when coupled with the distributed energy management system, can reduce a facility's annual expenditure for electricity by as much as 35 percent. Johnson Controls said that its energy management platform coupled with storage could save buildings up to 35 percent in electricity costs.

PRINCETON POWER SYSTEMS
Clean Power Made Simple™

EaglePicher Crossroads Facility

System Size: 1MW/2MWh
Components: Four (4) 45 ft. ISO Containers consisting of several GTIB-100 Inverters, multiple advanced Lead-Acid and/or Lithium-Ion batteries, PPS Site Controller, PV, Wind Renewable En- ergy Resource, and EaglePicher Power Pyramid Controller.
Loads: EaglePicher Crossroads Facility Installation Date: February 2012
Location: Joplin, MO

The system charges at low-cost energy times, such as overnight, and discharges selected battery banks at peak times to reduce power demand, and to manage local loads. The system can operate as a microgrid when disconnected from the utility service.

stem

data
analytics
power

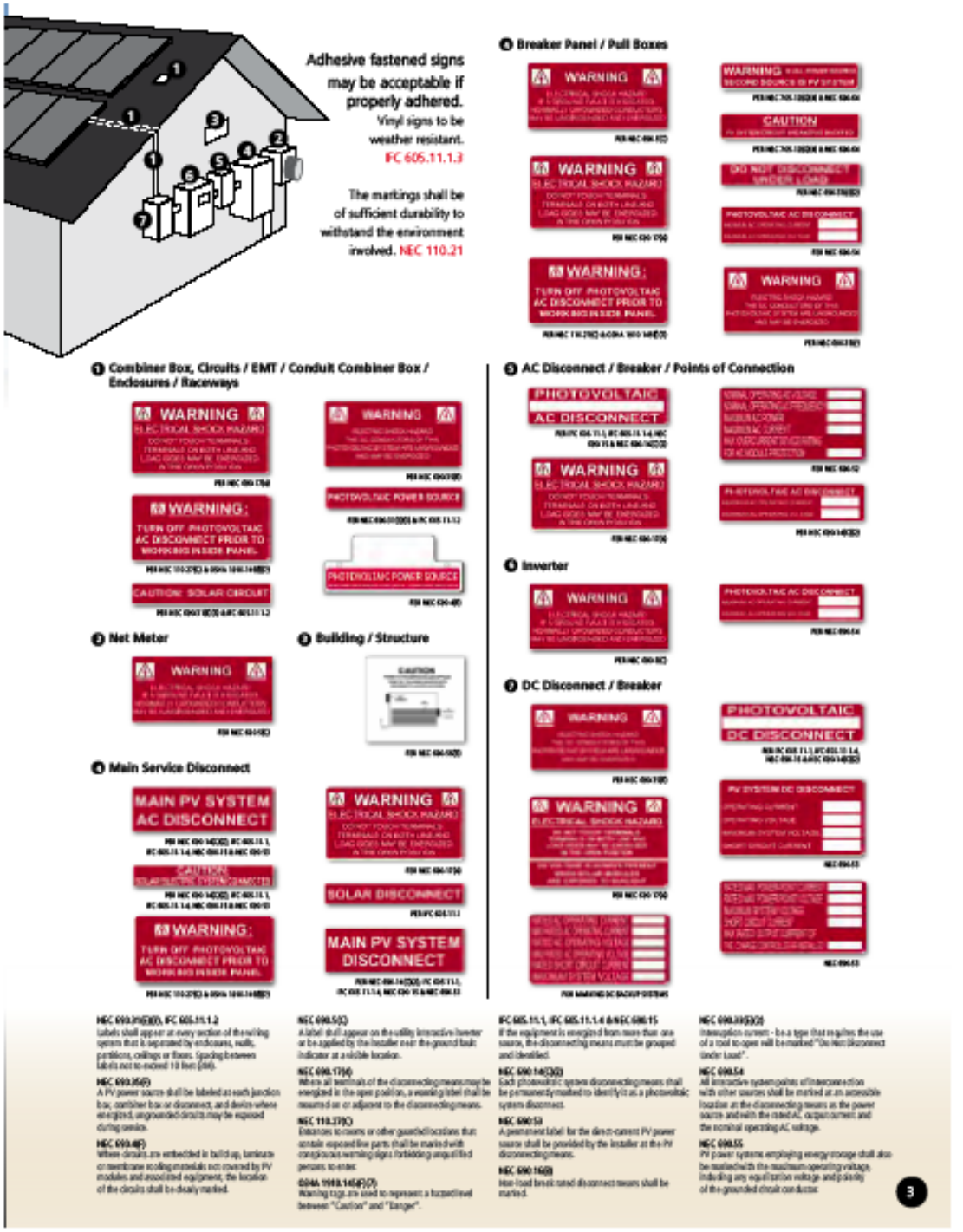
Stem creates innovative solutions that are changing the way energy is distributed and consumed. Stem combines powerful learning software and advanced energy storage, simultaneously helping businesses better manage energy costs while creating a more efficient electrical grid.

1.3 MW of intelligent energy storage from California-based firm, Stem, will be deployed at Park Place to reduce energy bills and strengthen the Southern California grid

CODE LABELING ISSUES:

Off-Grid Stand Alone systems must also have a plaque or marking at a readily accessible location (such as the building entrance) indicating that the building contains a Stand alone battery based electrical system and it should indicate where the disconnecting means is located at.

Battery containment or rooms (discussed in the last webinar) must be carefully labeled as well.



Questions?