

# Fortress Power

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## Energy Storage Systems

Paul Stepanoff, PE

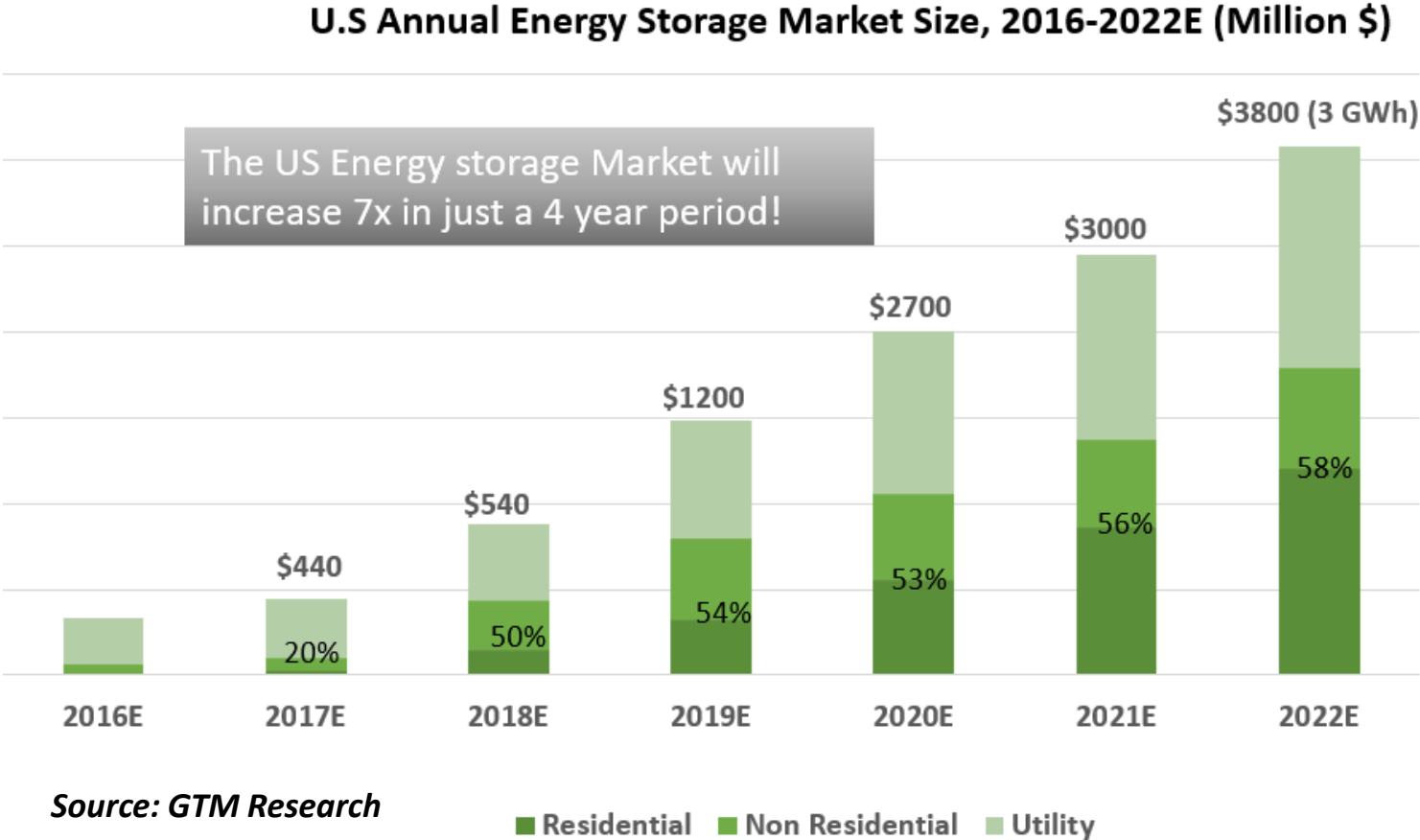


# Topic

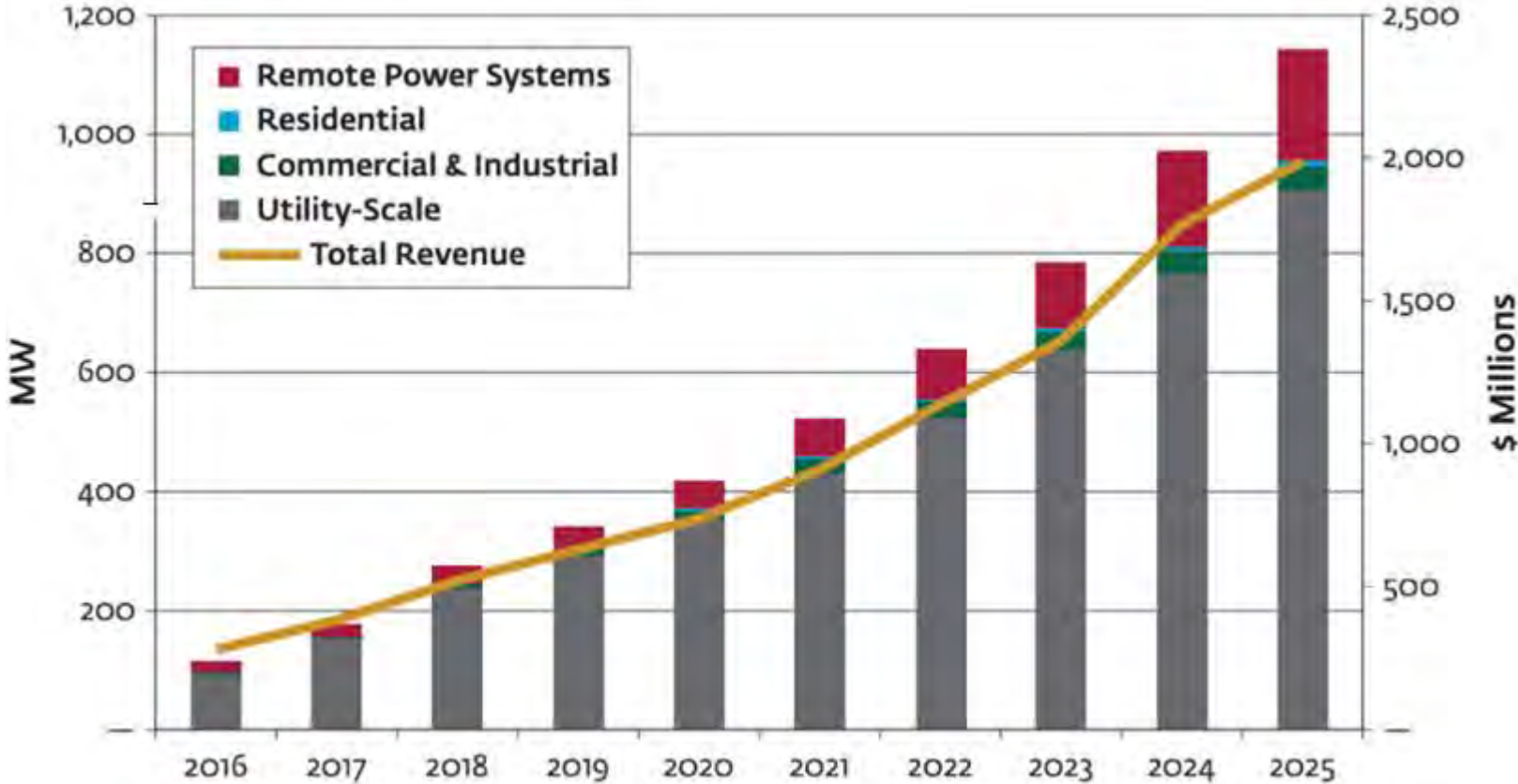
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- Growth Opportunity
- Company Introduction
- Fortress Lithium Battery
- Compatible Inverters
- Integration Guide
- Battery Technology Comparison
- Fortress Power Sizing Tool

# US Energy Storage Market



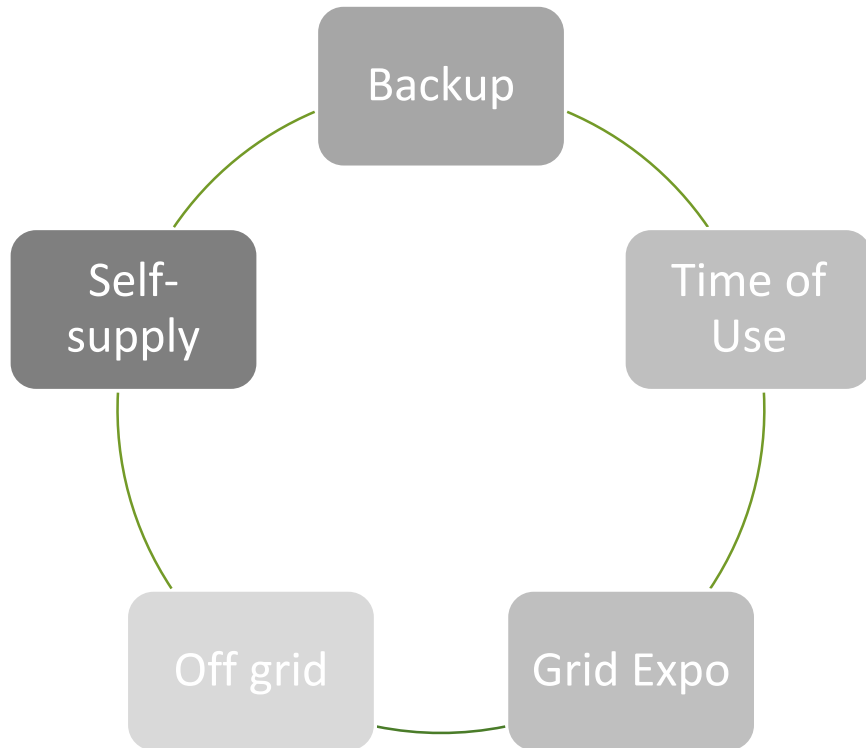
# Central & Latin America Energy Storage Market



Annual stationary Energy Storage Deployments by Segments Central & Latin America, (2016-2025); Source IFC ES Report

# Energy Storage Benefits

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## Back Up Your Facility

Power your facility when the grid is off; keep solar panels running during outages.



## Maximize Your PV Production

Store excess solar power for later use.



## Save Money on your Electric Bill

Charge the batteries at off-peak times; discharge them during peak periods.



## Tax and Incentives

30% ITC available if it's powered by solar; enjoy state and utilities rebates



# Company Introduction

# Company Introduction

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*A world-leading manufacturer who brings automotive Lithium Iron Phosphate batteries to the energy sector*



U.S Headquarters, Southampton, PA  
(30,000 Sqf )



Manufacturing Facility, Shenzhen China  
(since 2008)

# Fortress Lithium Battery



# Lithium Ferro Phosphate Technology

*We incorporate the safest technology available into our batteries.*

	<b>Fortress Power</b>	<b>Tesla, LG Chem, Panasonic</b>
Chemistry	Lithium Ferro Phosphate (LFP)	Lithium Ion or Nickel- Magnesium -Cobalt (NMC)
Safety	✓	X
Eco-friendly	✓	X
Life Cycles	6000	< 3000
Operating Temperature	32– 140 °F	32 – 113 °F
Degradation Rate		LFP < NMC
Energy density		LFP < NMC

*Search LFP vs. NMC nail test videos on YouTube*

# Fortress Lithium Batteries

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**LFP-10**



**eVault 18.5**



- ✓ ***Safe Lithium Chemistry***
- ✓ ***Large Capacity for Easy Installation***
- ✓ ***98% Round Trip Efficiency***
- ✓ ***Long Lasting***
- ✓ ***Competitively Priced***
- ✓ ***Lowest Cost Per Cycle***
- ✓ ***Maintenance-free***

# Smart Battery Management System (BMS)

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## *Multilevel Safety Concept for Highest Reliability*

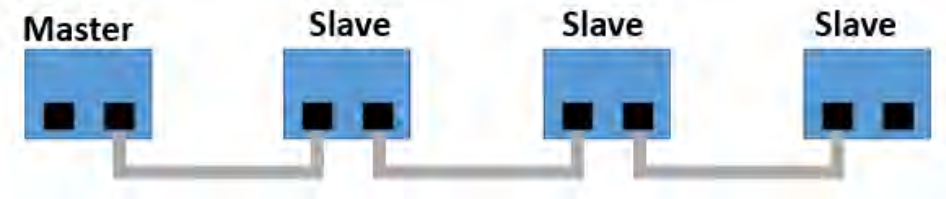
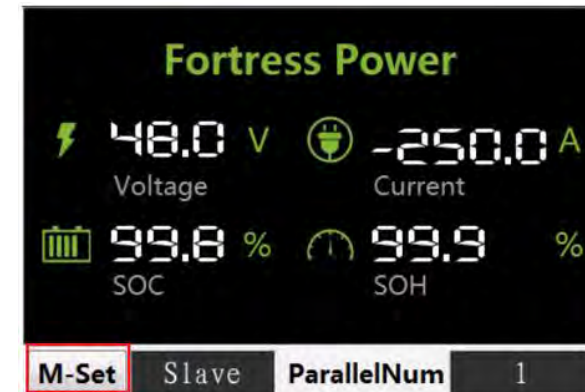
- ✓ Overcharge and Deep Discharge Protection
- ✓ Over-heat Protection
- ✓ Over Current Protection
- ✓ Cell Monitoring and Balancing
- ✓ Voltage and Temperature Monitoring



# LCD Monitoring of eVault 18.5

## Information on LCD Display:

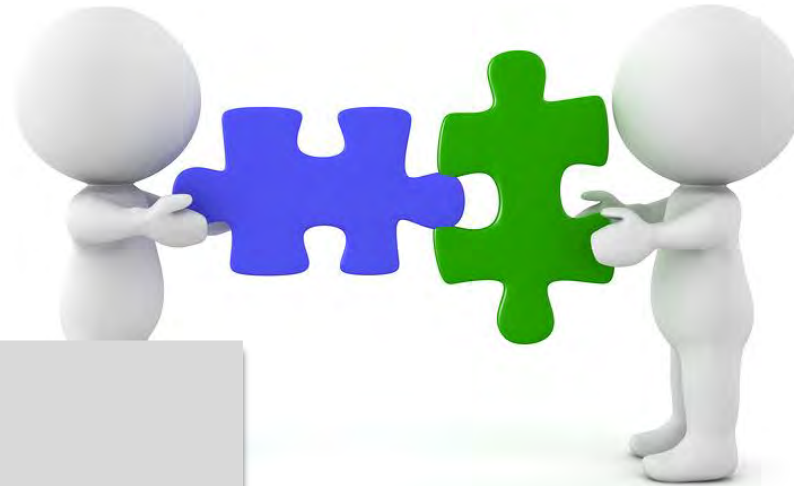
- ✓ Voltage
- ✓ Current Output
- ✓ State of Charge
- ✓ State of Health
- ✓ Safety Warning: Over-charging & -discharging;  
Over Current; Over-Heat
- ✓ Voltage of slave units



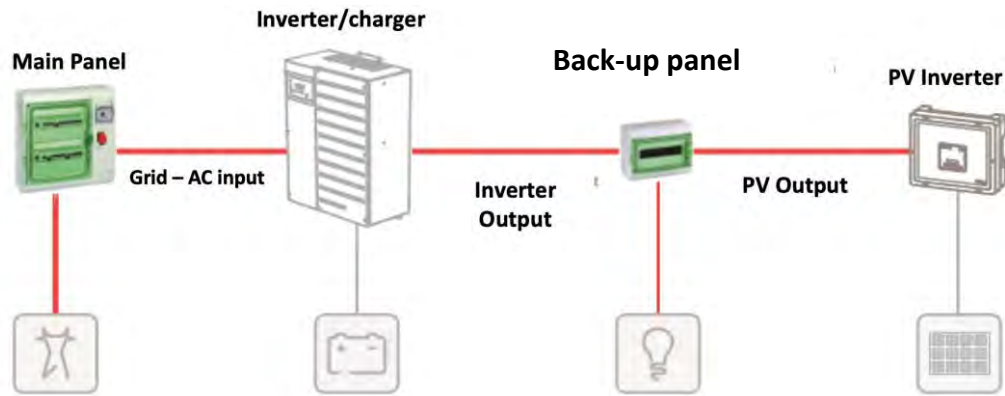
# Technical Specification

	<b>LFP-10</b>	<b>eVault 18.5</b>
<b>Total Energy [KWH]</b>	10.2	<b>18.5</b>
<b>Usable Energy [KWH]</b>	10.2	16.5
<b>Capacity [AH]</b>	200	360
<b>Battery Voltage [V]</b>	48V	
<b>Max. Charge Current (Continuous) [A]</b>	80	150
<b>Max Discharge Power (Continuous) [KW]</b>	5 (100A)	8.2 (160A)
<b>Peak Output [KW]</b>	7.5 (150A)	12 ( 240A)
<b>Parallel Stacking</b>	2	8
<b>LCD Monitoring</b>	No	Yes
<b>Communication</b>	N/A	CAN/RS485
<b>Warranty</b>	5/10 years; up-to 6,000 cycles	

**Compatible Inverters**



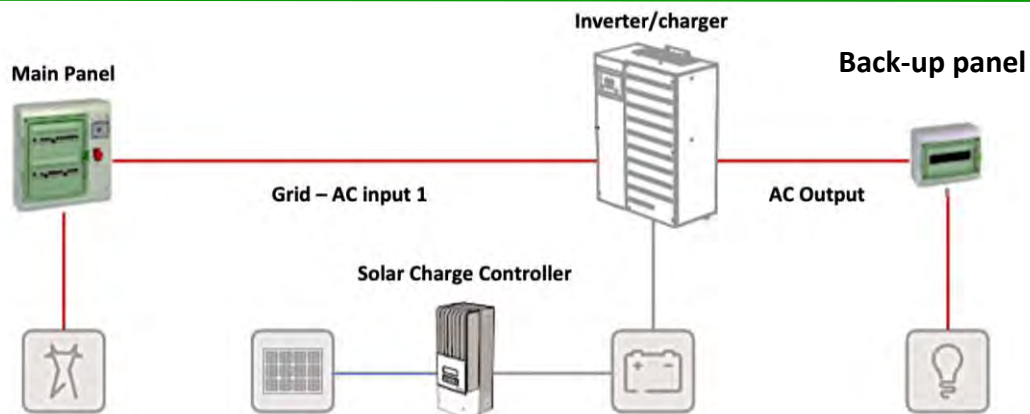
# AC vs DC Coupled Solution



**AC-Coupled System Diagram**

## Application for AC coupled solutions

- *When retrofitting to existing PV systems*
- *For new installations that require module level rapid shutdown*



**DC-Coupled System Diagram**

## Application for DC coupled solutions

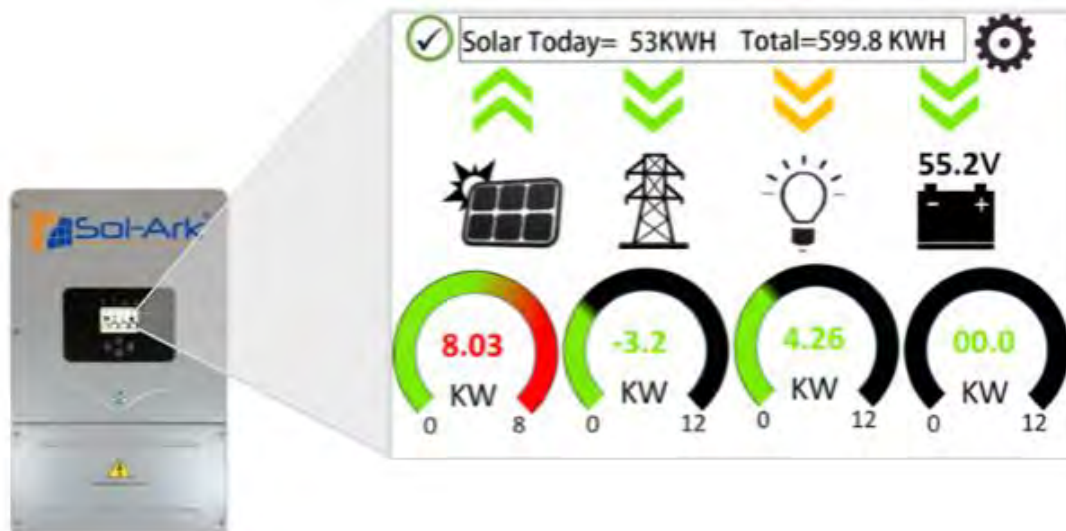
- *For new installation*
- *No additional PV inverter*
- *More efficient*

# Compatible Inverters

*COMPATIBLE WITH MOST 48V CHARGERS AND HYBRID INVERTERS!*

<b>Brand</b>	<b>Inverter/Charger Mode</b>	<b>Configuration</b>
Sol-Ark	8 KW Inverter	AC or DC coupled
Schneider	Conext XW MPPT charge controller; Conext XW+ series; Conext SW;	AC or DC coupled
Outback	Skybox, FLEX max charge controller (48V), FLEXpower series (48V); Radian series (48V); FXR(A) and FXR (E) series (48V); GVFX and GVFX series (48V);	DC coupled
Magnum	MS 4448PAE; MS 4048-20B	AC or DC coupled
SMA	SUNNY ISLAND 4548-US/6048-US; SUNNY ISLAND 3.0M/4.4M/6.0H/8.0H	AC coupled
Victron	Phoenix VE.Direct Inverter; MultiPlus and Quatro Inverter/Charger; Skylla-TG Charger; General; Color Control or Venus GX	DC coupled
Morning Star	TriStar MPPT 600V; TriStar MPPT; Tristar PWM	DC coupled
Midnite Solar	Solar Classic 150, 200 & 250; Solar Classic 150, 200 & 250-SL	DC coupled

# FORTRESS + SOL-ARK 8KW (AC & DC Coupling)



**Available in our stock!**

## Key features:

- *All in one unit (Off-Grid; Time-of-Use; Self-Supply; Back-up; Grid export)*
- *Extreme Compact & Easy Installation*
- *DC Coupled & Transform-less*
- *The best Roundtrip efficiency: 93%*
- *High Surge Power: 20KW*
- *Auto-Gen Start included*
- *Allows to use Gen Output to AC couple to an existing PV array*

# Technical Specification

	Output to the Critical Load		Output to the Grid
	On Solar or Battery (Back-up)	With Grid or Generator Present	Pass-through
AC Output Power	8 KW	12 KW	12 KW
Surge power	20 kW (5 Sec)		
AC Output Voltage	120/240V & 120/208V		
UPS Grid Failure Transfer time	12 kW auto-transfer relay at 2ms		
PV Array in DC Coupling	Up-to 11 KW		
PV Array in AC Coupling	Up-to 7 KW		
PV Array in AC & DC Coupling combined	Total max 13 KW		
Module-level rapid shutdown Compliance	Adding Tigo Optimizers		
Storage capacity	10/16.5 KWH per unit; scalable to 132 KWH		

# Fortress + Schneider XW+ (AC & DC Coupling)

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## Key features:

- *Over 10 years in operation*
- *All in one unit (Off-Grid; Time-of-Use; Load shifting; Back-up; Grid export)*
- *Allows DC & AC coupling*
- *Single or three phase systems from 7 kW to 102 kW*
- *Performs in hot environments up to 70°C*
- *Auto-Gen Start optional*



# Technical Specification

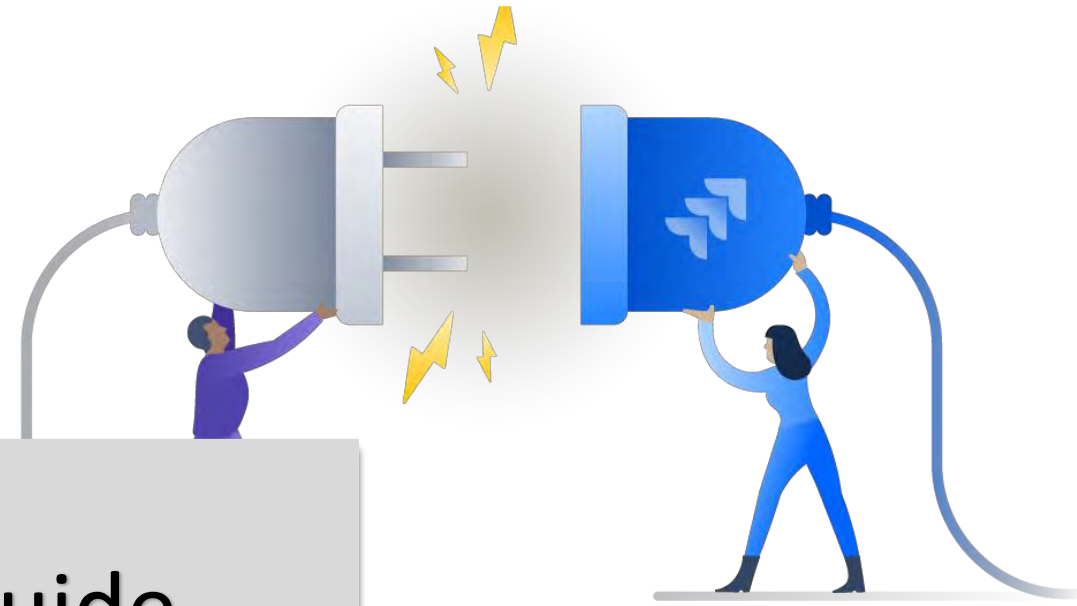
	Technical Specification	
Inverter AC output	5.5 KW	6.8 KW
Surge power at backup	7/9.5 kW (30 min/60 sec)	8.5/12 kW (30 min/60 sec)
Storage capacity	10/18.5 KWH per unit; scalable to 148 KWH	
UPS Grid Failure Transfer time	Built-in 60A auto-transfer relay at 8ms	
Compatible PV Inverters	AC-coupled to Enphase, AC modules, Solaredge, SMA, Fronius 10 kW+, etc.	
Stack-ability	<ul style="list-style-type: none"> <li>▪ Max. 4 in 1-Ph (120/240V)</li> <li>▪ Max. 9 in 3-Ph (120/208V): 3 units per phase</li> </ul>	
Requirement	<ul style="list-style-type: none"> <li>▪ PV Watts <math>\leq</math> XW+ Max Continuous AC output</li> <li>▪ PV Watts /48V = PV array's Max Charging Current <math>\leq</math> Battery Max Charging Current **</li> </ul>	

\*\*Example: 7.5 KW PV array /48V = 156 A



6.8 kW/30 kWh ESS

# Integration Guide



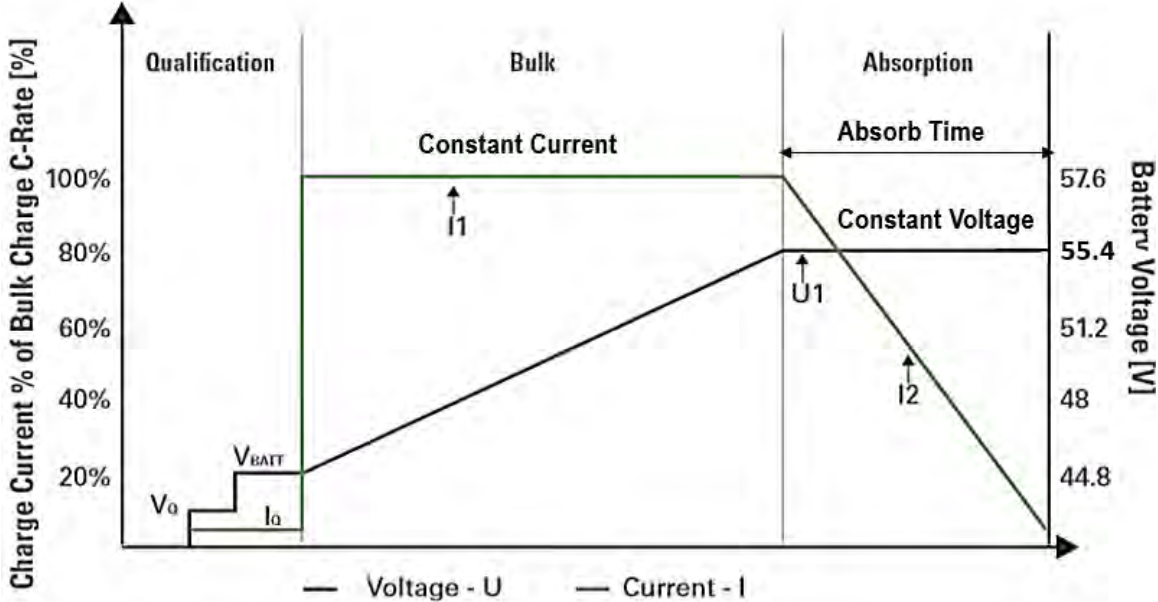
# Integration Guide-Inverters/Charger Setting

Charger/Inverter configuration recommendation for best performance:

	3000 Cycles	6000 Cycles
Equalized Support	Off	Off
Capacity Limit	LFP-10: 200Ah / 18.5: 360Ah	
Equalized Voltage	Off	Off
Recharge Voltage	47V	49V
Bulk Voltage	57.6V	55.4V
Absorb Voltage	57.6V	55.4V
Low Battery Cut Out Voltage	48.4V (48V)	50.7V (48V)
High Battery Cut Out Voltage	70V	70V
Float Voltage	OFF/unless use as back up (54.4V)	
Max Charge Current	LFP-10: 80A per battery eVault 18.5: 150A per battery	LFP-10: 50A per battery eVault 18.5: 100A per battery

*The Battery Parameter Setting Guides with Schneider, Outback and SMA inverters are available to download on [www.fortresspower.com/Resource](http://www.fortresspower.com/Resource)*

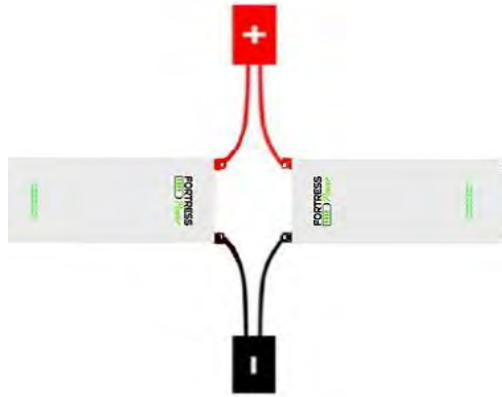
# Fortress LFP Battery Charging Curve



	Lithium Ferro Phosphate (LFP)	Lead Acid
Absorb time	6 min	120min
Float Charge	N/A	✓

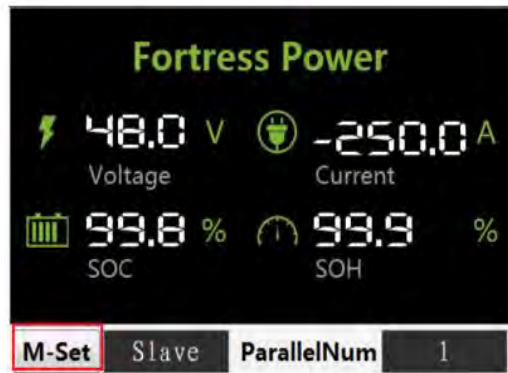
# How to Parallel Fortress Batteries

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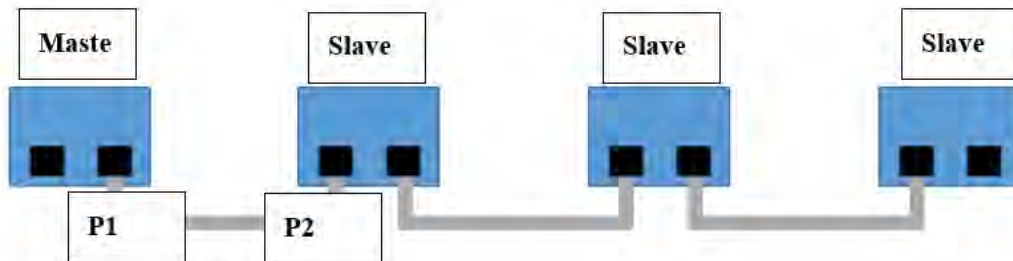


- Common Bus is recommend!
- Please do not cross the positive and negative terminals
- Use a volt meter to check polarity before connecting terminals.
- Measure voltage and make sure difference is less than 0.5V before turn on
- During installation breaker on “OFF” position

# How to Parallel eVault 18.5

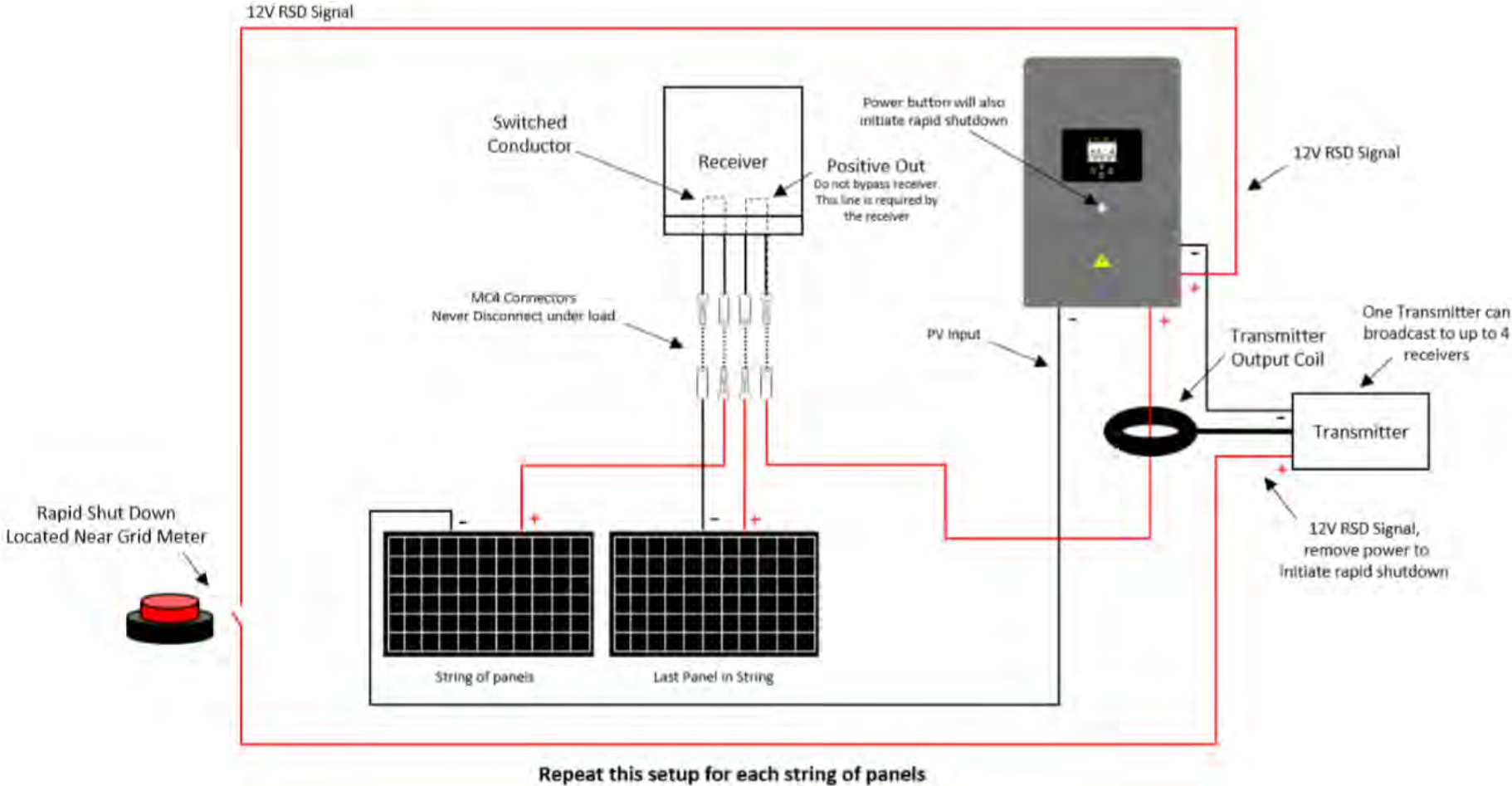


RS 485 cable

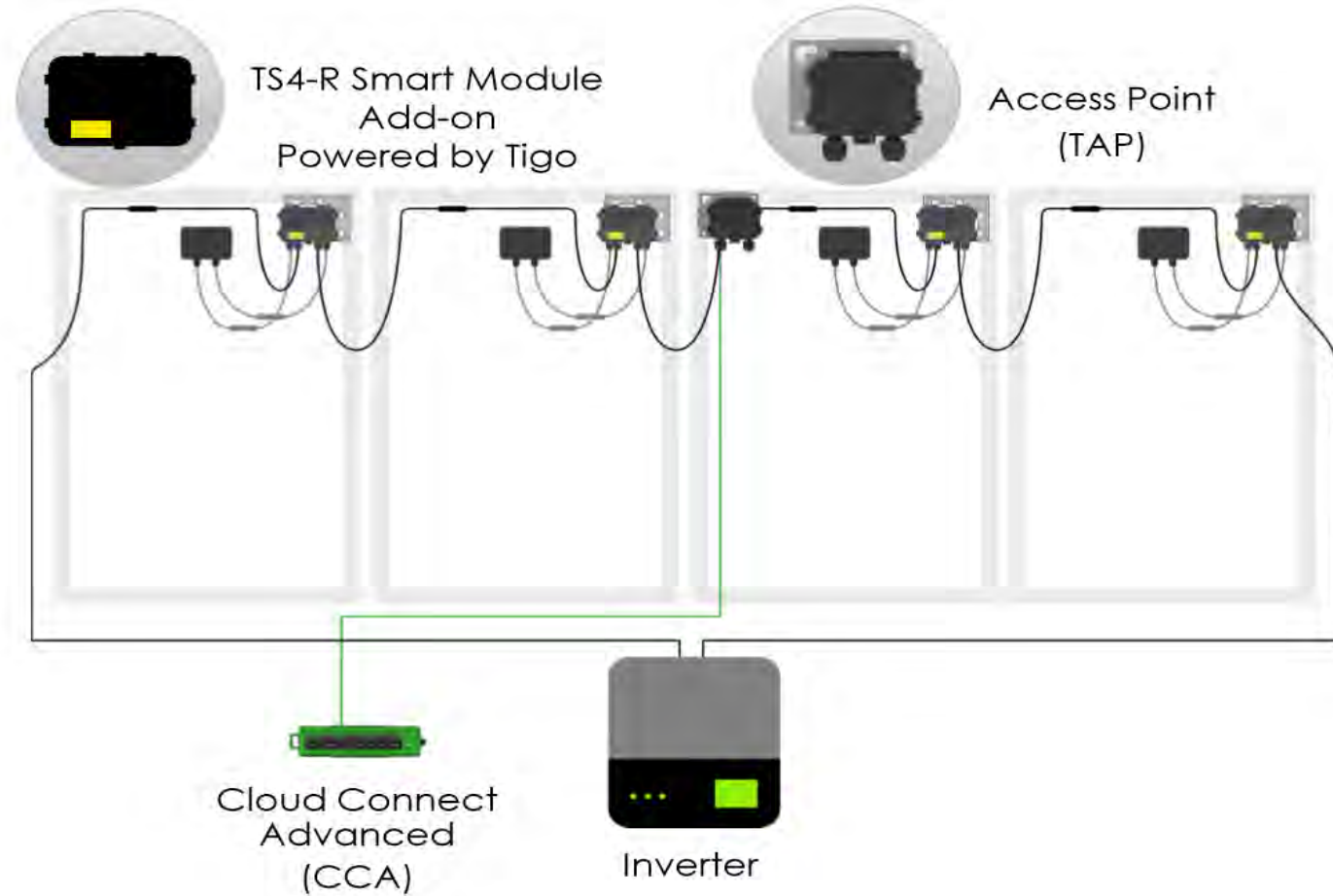


1. Push “M-Set”, set the first battery pack as “Master.”
2. Push Parallel number: put how many battery you put in parallel in the system. For example, 3 batteries should be.
3. Check the voltage of slave units on the Master’s Screen
4. You should hear relay start connecting battery to the system, check each battery status.

# Integrating Midnight for String Level Rapid Shutdown



# Integrating Tigo for Module Level Rapid Shutdown

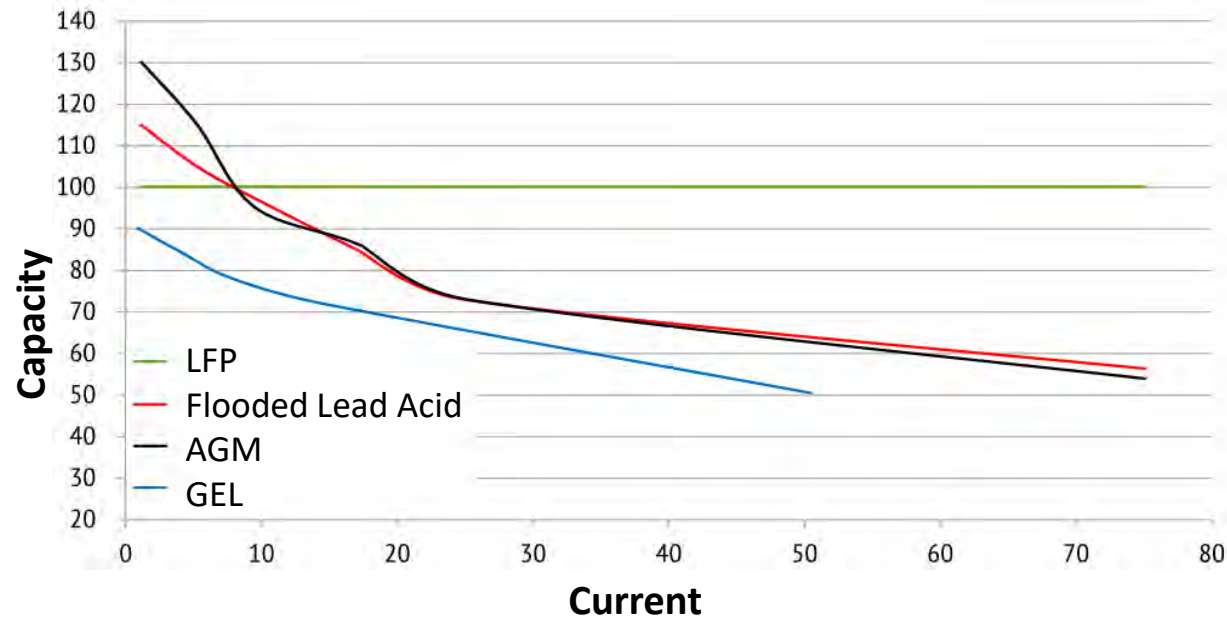




# Battery Technology Comparison

# Performance Comparison

LFP vs Lead Acid at various discharge rate

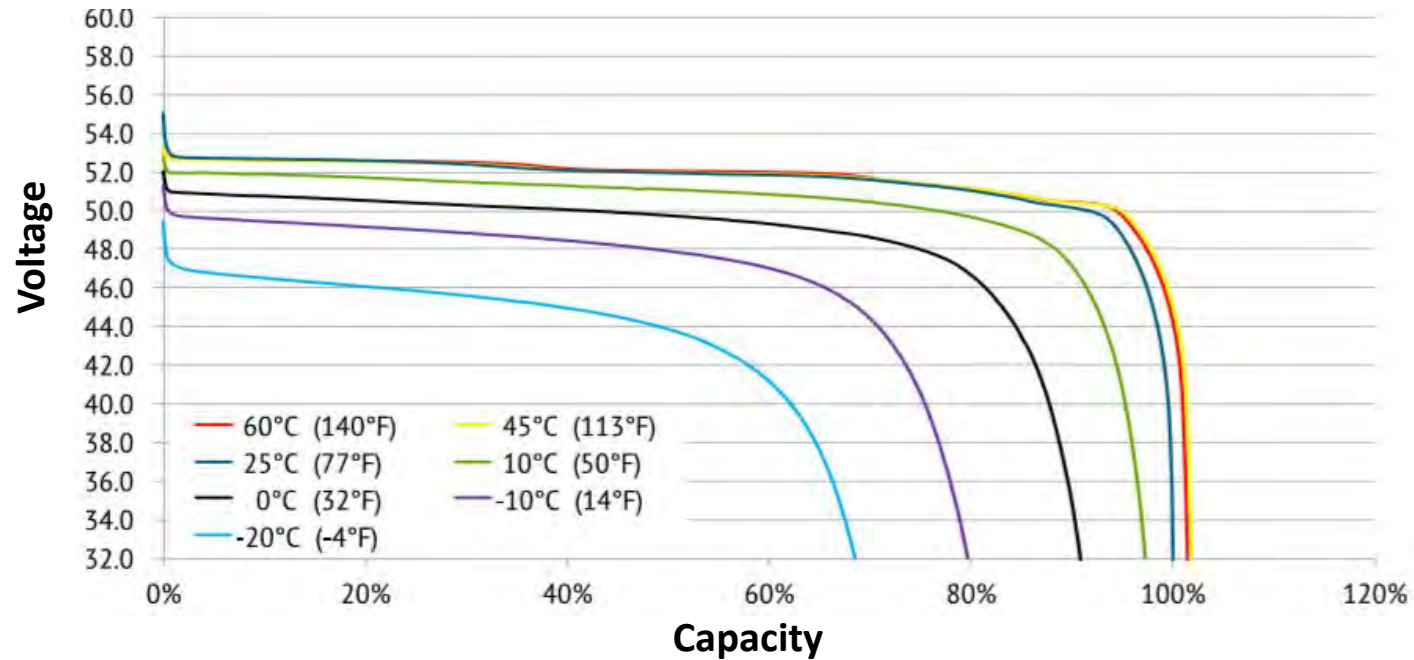


## Disadvantages of Lead Acid:

- *Capacity drops significantly when output current increases*
- *6 times more space*
- *Higher cable cost and longer installation time*

# Temperature Impact on Performance

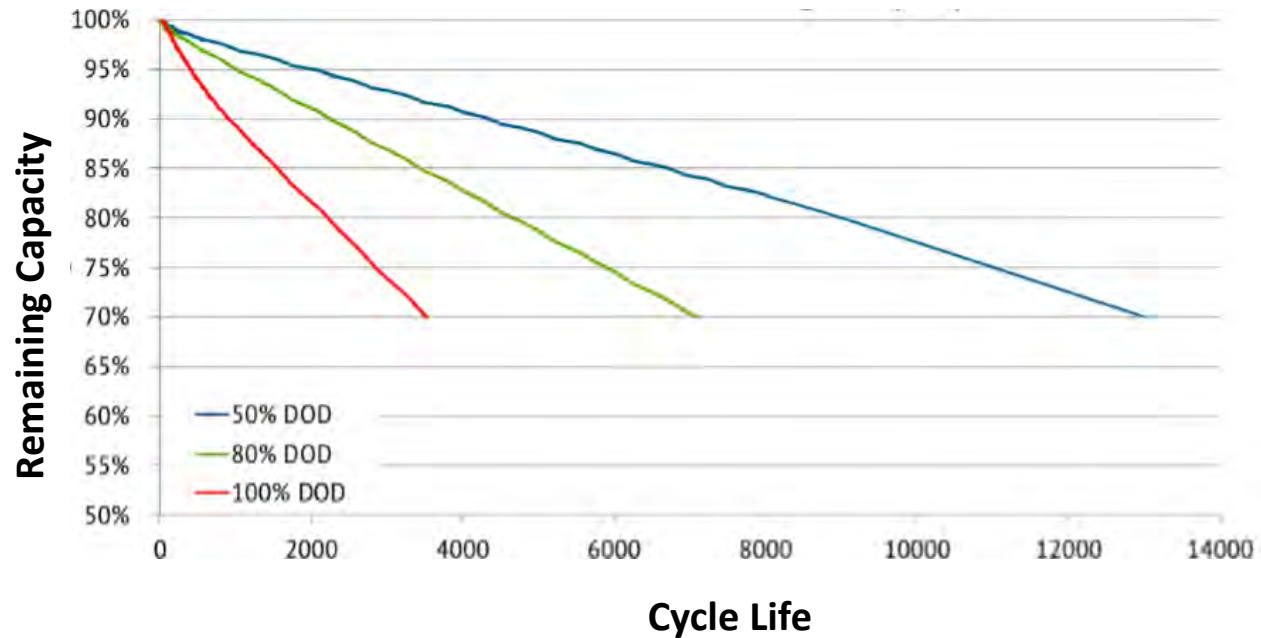
Discharge Voltage of LFP in Relation to Temperature  
@ 0.5C discharge rate



	3000 Cycles	6000 Cycles
Temperature Range	32 F to 130F (0 °C to 49°C)	10 F to 110 F (0°C to 43°C)

# Cycle Life vs Depth of Discharge

Cycle Life in Relation to Depth of Discharge (DoD)  
@ 0.5C charge/discharge



	3000 Cycles	6000 Cycles
Depth of Discharge	90%	80%

# Comparison of different Battery Technologies

	Fortress LFP	Lithium Ion	Li-Polymer	Flooded LA*	AGM*	Carbon AGM*	Nickel Iron*
Round trip efficiency	98%	95%	95%	80%	88%	94%	65%
Cost of 10 kWh Usable Power (MSRP)	6,900	6,999	4,500	2,800	3,600	5,000	18,000
Cycle Life	6,000	2,500	1,500	600	750	2,400	8,000
Off Grid Years	16.4	6.8	4	2.7	2	6.5	21.9
Cost per Cycle per kWh	0.11	0.28	0.30	0.46	0.48	0.21	0.23
Safety	Yes	No	No	No	No	No	Yes
Free Maintenance	Yes	Yes	Yes	No	Yes	Yes	No

\* Lead Acid, AGM, Carbon AGM and Nickel Iron can only be discharged to 50%; additional battery rack is required!

**30% ITC only applies to the first install!**

# Performance Comparison

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**48V, 240AH  
AGM Battery**

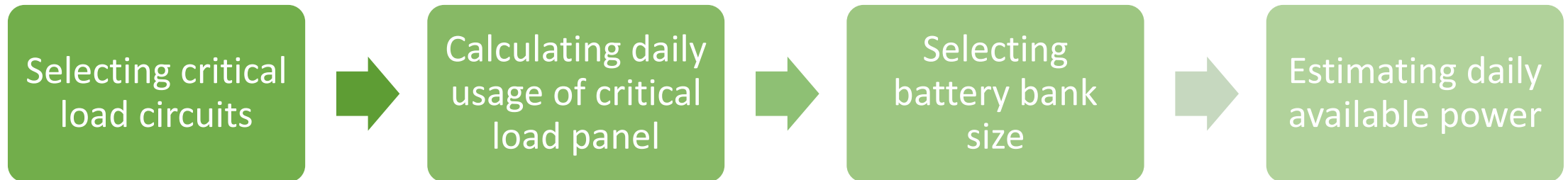


Fortress Storage Sizing Tool

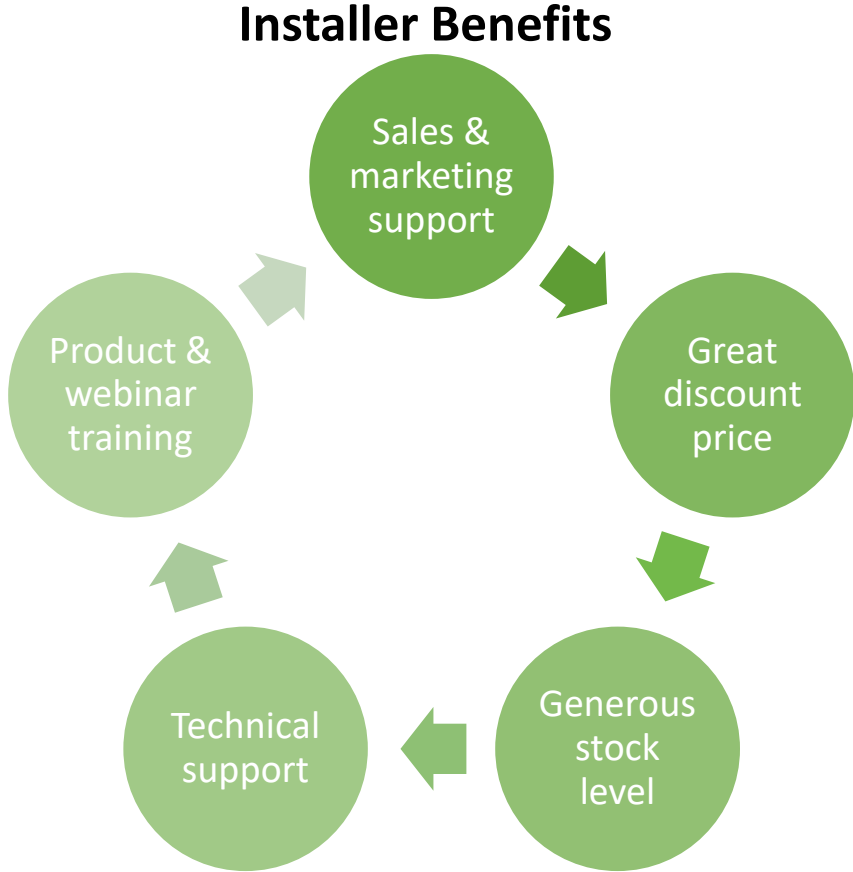
# Fortress Energy Storage Sizing Tool

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## 4 Steps to Size Up Energy Storage for Backup



# Authorized Installer Benefits

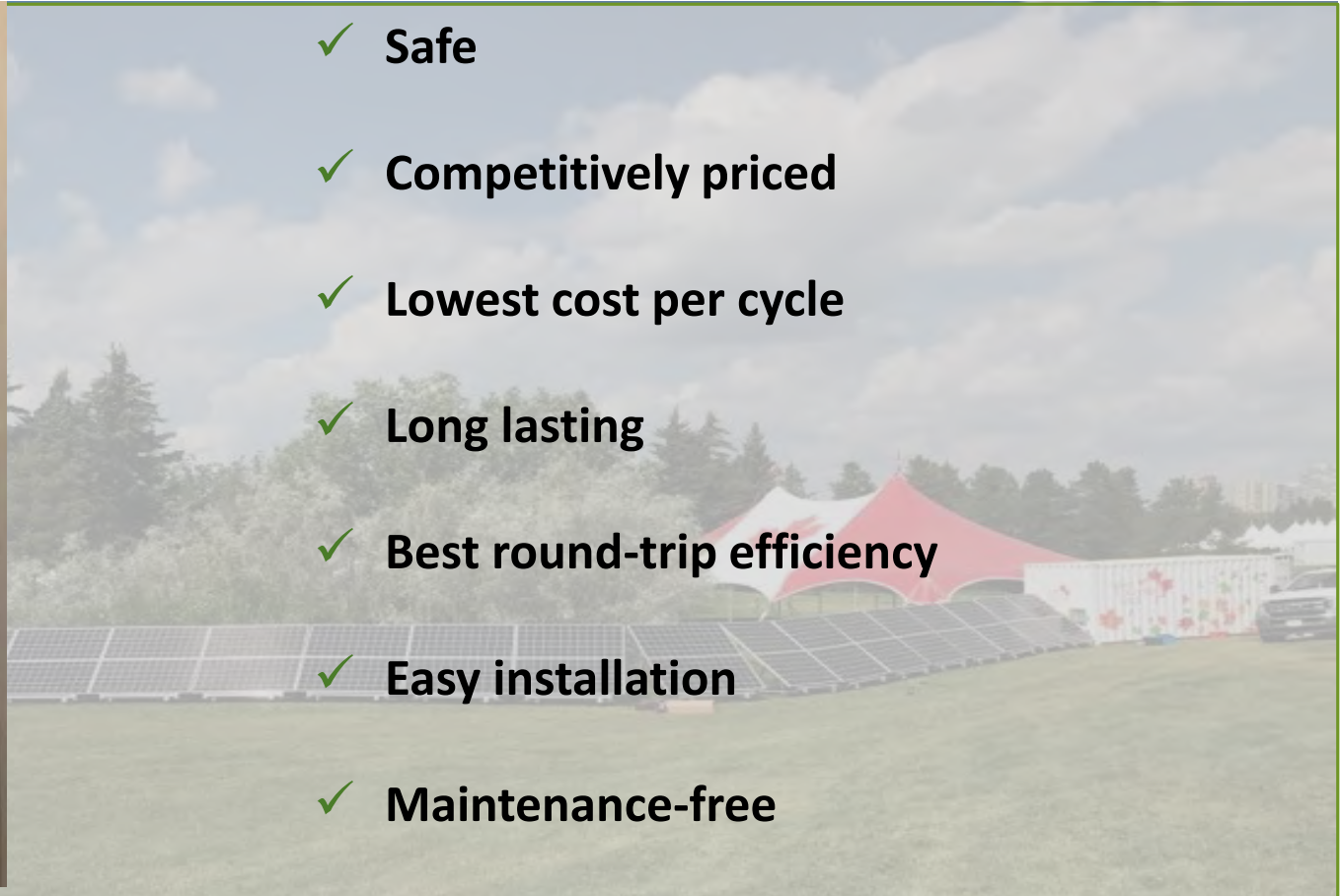


Becoming

**Fortress Power**  
*Authorized Installer*



# Our Product Advantages



- ✓ **Safe**
- ✓ **Competitively priced**
- ✓ **Lowest cost per cycle**
- ✓ **Long lasting**
- ✓ **Best round-trip efficiency**
- ✓ **Easy installation**
- ✓ **Maintenance-free**

# Thank You & Contact Us

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www.fortresspower.com

If you want to go fast, go alone;  
if you want to go far, go together!