



Battery Based Energy Storage

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Many Ask:

What is the Return On Investment on Battery Based Systems?

Battery Based Systems are not based on ROI!

Battery Based Systems is an Emotional Choice!

NOT an Economic Choice!

You can't approach a Battery Based System like you would on a Grid Tied Solar System.

Battery Based Systems are generally installed for two reasons:

Your Home is not on the power grid.

Off Grid.

Your utility is unreliable.

Grid Connected Backup

Off Grid:

Many Homes that are built where there are not power lines.
Generally systems can run from as low as \$15,000 but I personally have been involved with systems as high as \$175,000.

Cost depends on how much load the customer wants to run.

Off Grid:

Getting power in remote locations can be cost prohibitive...

Each power pole installed is approximately 130 feet apart. Each pole can cost in the range of \$500-\$1000+.

For each mile, before you consider environmental, clearing, or road access can cost in the ballpark of \$40,000+ or more

I have seen quotes in the \$250,000 to install utility power!

Off Grid:

System must be sized according to the customers loads.

System must be balanced so that batteries see a full charge often even in winter.

Customers must be educated how to operate the system.

Grid Connected Backup:

In Washington, these systems are primarily backup, but in the past, there have been some Battery Based inverter sold for Grid-Tie Sell Back systems.

These systems are sized to:

1. Provide backup power when there is a service interruption.
2. Provide Grid-Tied Sellback and backup during service interruption.

Grid Connected Backup:

These systems need to be designed to backup necessary loads during an outage... If client needs the entire home backed up system gets exponentially larger, and thus more expensive.

Ideally you size for necessary loads only in a secondary sub panel and most will size lead-based batteries for 80% DOD or 100% for LFP.



Battery Bank Sizing Considerations

You Must understand what type of System Your Customer wants:

- Grid-tied without Batteries.

- Grid-tied with Batteries. (Support)

- Grid backup

- Off-grid

You Must “Interview” Your Client to assess what they need

Sizing....

Common Theme between all systems.

Battery based systems must be balanced.

My Favorite Questions:

“I have a 3-bedroom House how much is this going to cost me?”

“I have an 1800 (sq f OR m²) House how much is this going to cost me?”

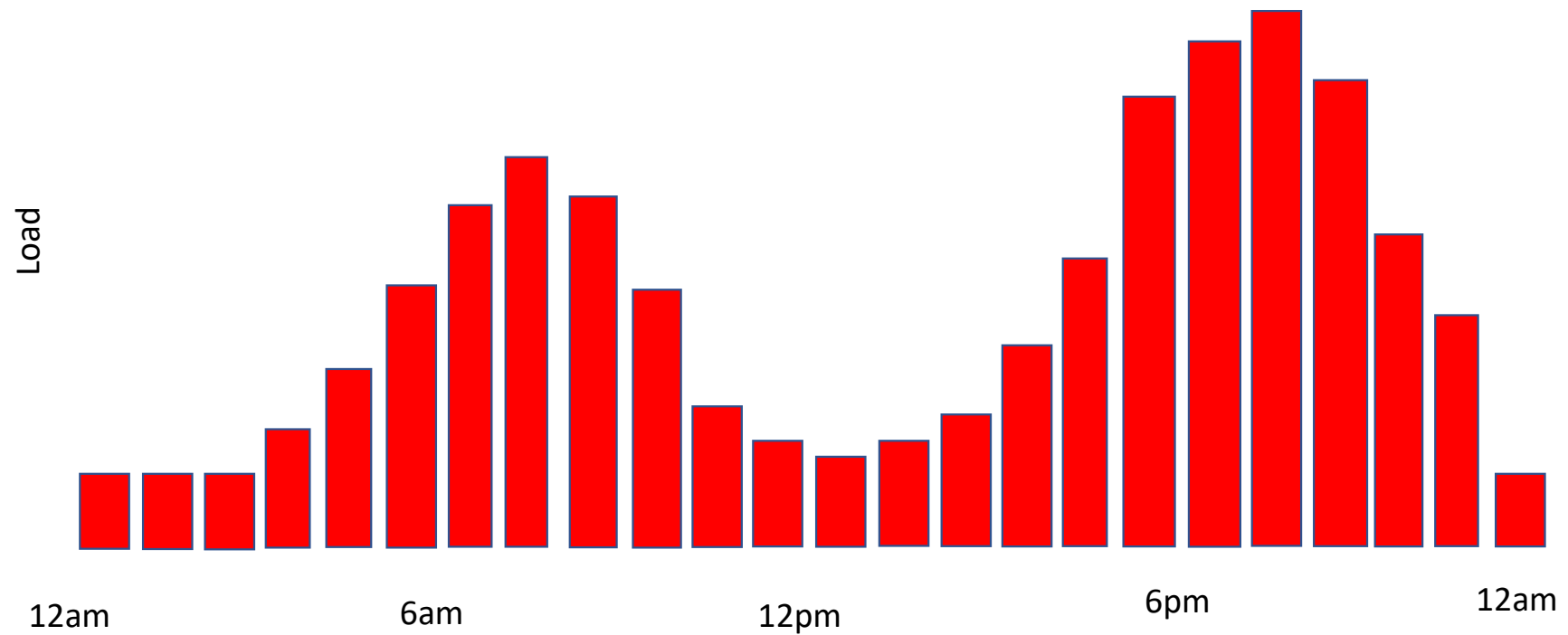
What Color is the House?

SYSTEM SIZING CONSIDERATIONS

- Q – What are they wanting to power?
- Q – Why do they need....?
- Q – Do they have room to install a system?
- Q – Have they completed an Energy Load Evaluation? If not, RUN!.
- Q – Is this a rational & appropriate client?
- Q – Is the client going to stay within sized loads (Possible Expansion)?
- Q – How much time do (will you) you have to baby-sit this client?
- Q – Has this client ever stayed or lived in an Off-Grid house?
- Q – What are their expectations from this system?
- Q – Is the client going to properly maintain a battery bank or System?
- Q – Can they Afford to live Off-Grid?
- Q – ?

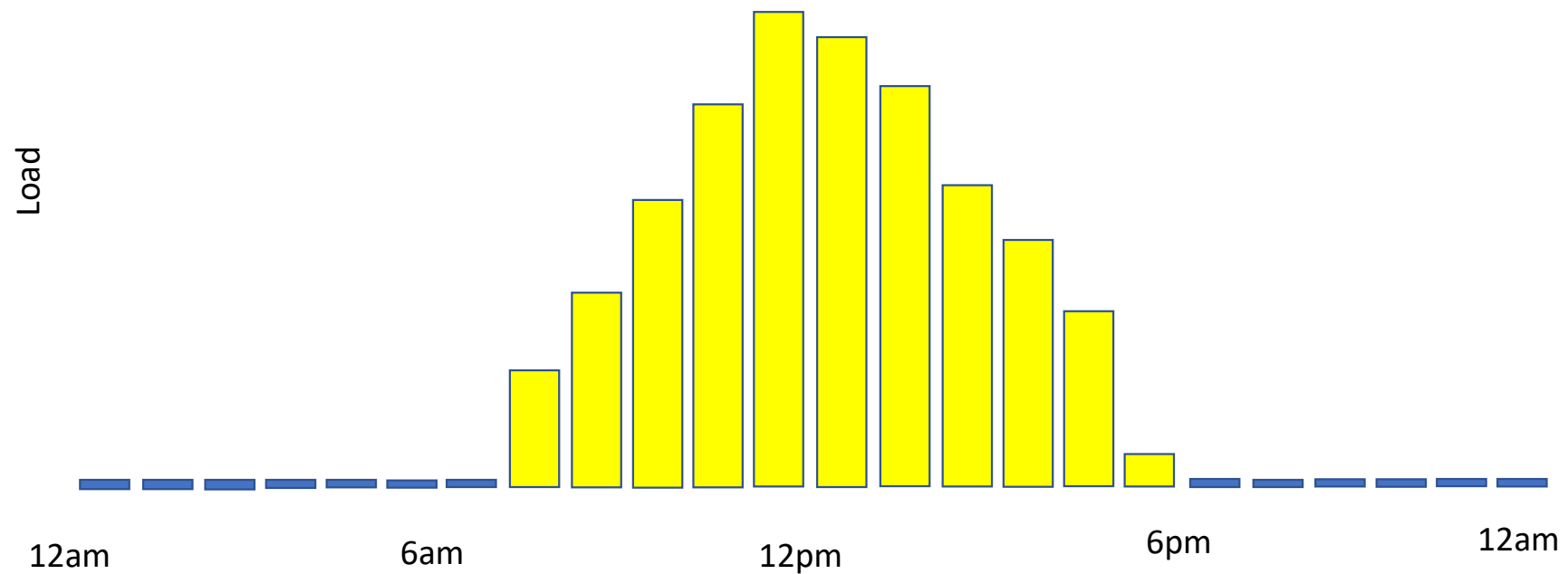
SYSTEM SIZING CONSIDERATIONS

Load Profile



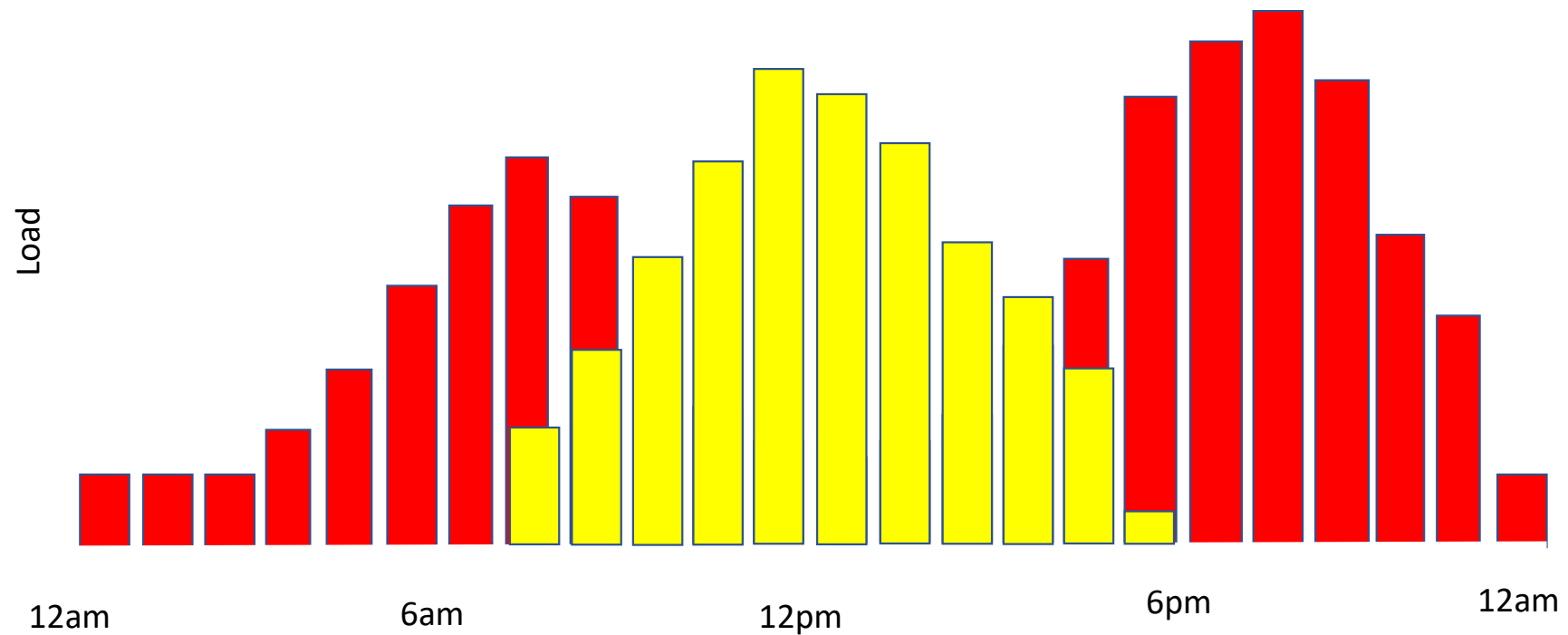
SYSTEM SIZING CONSIDERATIONS

Sun Profile

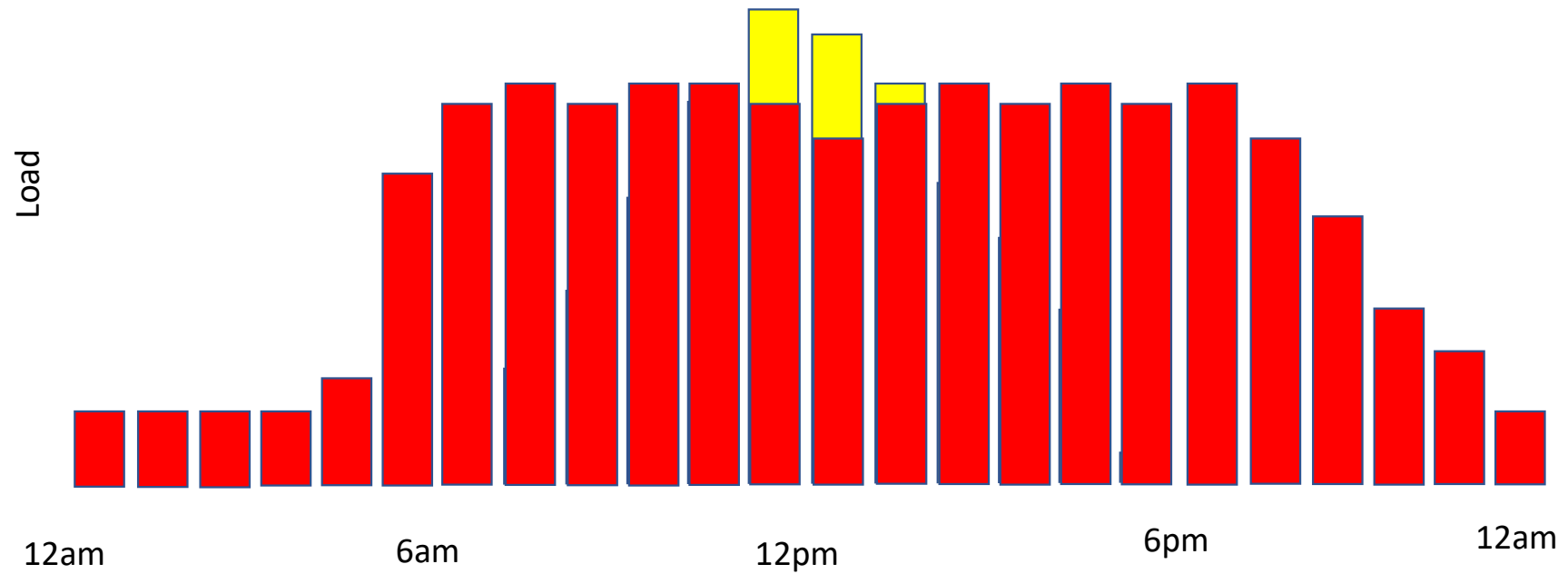


SYSTEM SIZING CONSIDERATIONS

Load Profile/Sun



SYSTEM SIZING CONSIDERATIONS



Other Things You need to Consider:

Time of Use: When is the customer using power?

Type of Use: Is the Client a full-time off grid? Backup? Cottage?

Your Client: Are they going to take care of it?

SYSTEM SIZING CONSIDERATIONS

EXAMPLE OF POWER CONSUMPTION

LOAD CATEGORY	ESTIMATED DAILY CONSUMPTION
LIGHTING	2.4 KWH
REFRIGERATION	1.5 KWH
HEATING	3.2 KWH
MISC ELECTRONICS	3.9 KWH
WATER PUMPING	.75 KWH
KITCHEN APPLIANCES (NOT INC REFRIGERATOR)	1.0 KWH
LAUNDRY	1.0 KWH
OTHER	2.0 KWH
TOTAL	15.75 KWH/DAY



Common System Sizing Mistakes.

- Oversizing of the Battery Bank.
 - Too Many Parallel Strings
 - As the battery bank gets larger, often so does loads.
- Shoehorning Product.
 - Sell the right solution into the job, not what you have in stock
- Not understanding “C” Rates.
 - Lighter use = Larger bank
 - Heavier use = Smaller Bank
- Make sure you understand the product you sell
 - Read the documentation of the products you are installing!
 - Properly Program All equipment in system.

- Insufficient Solar or other renewable source installed
 - There is no reason not to oversize solar in today's world
- Consider Load use By Time of Day
 - You may need to make the solar larger to handle the load AND the charging of the batteries
- Solar Production is different thru the year!
 - If you size the solar for best case, come winter you are going to have to run a generator... A LOT!
- Not understanding the +/- of different Battery Chemistry's
 - Calcium Batteries are Different than Lead Antimony.
- Trying to get too accurate on the system sizing
 - Miss high, not low!

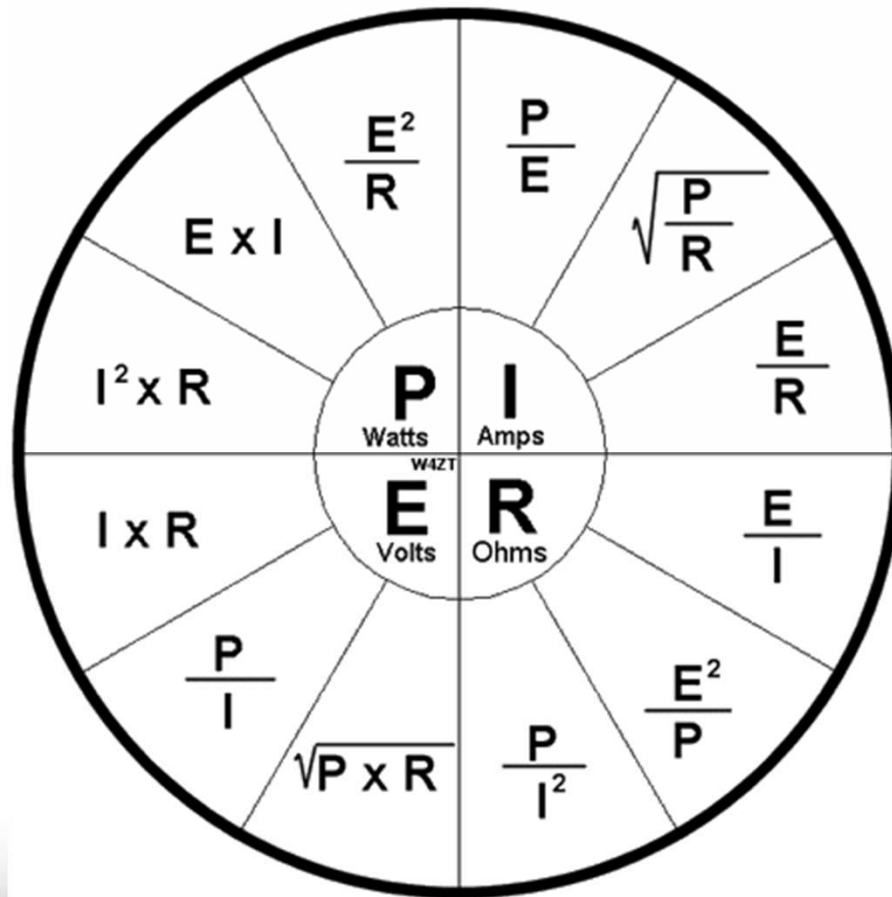
- Not taking in account both warm and cold temperatures.
 - Warm Temps of just 35C will reduce cycle lives by 50%!
 - Cold Temps will reduce capacity. -9C temps will reduce capacity by 63%!
- Not understanding the difference between a 12-volt battery bank and a 48-volt battery bank.
 - 12 V 3000 Ah = ??
 - 24 V 1500 Ah = ??
 - 48 V 750 Ah = ??

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 - 12 V 3000 Ah = 36,000
 - 24 V 1500 Ah = 36,000
 - 48 V 750 Ah = 36,000



Sizing Calculations.

BATTERY BANK SIZING CALCS



Common Calculations

Watts = Volts X Current

Volt = Power / Current

Disclaimer:

There are 100's of ways to calculate Solar system needs.
The following calculation are just the beginning of attempting to determine, just how much energy storage you need.

This is just the what I've developed over the years to speed up the design of a system.

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OTHER	2.0 KWH
TOTAL	15.75 KWH/DAY

SIZING-Amp Hour

15.75 kwh of daily load @48V

$15,750 / 48$ nominal battery voltage = 328 ah

$328 \text{ ah} / .5$ (Assumed 50% DOD) = 656 ah

10-20% assumed losses (15%) $\times 1.15 = 754.4 \text{ ah}$

For one day of autonomy you'll need 754.4 ah of battery bank capacity

SIZING-Watt Hour

15.75 kwh of daily load @48V

15,750 + 10-20% (15%) * 1.15 assumed losses

18112wh /.5 (50% DOD) = 36,224wh

For one day of autonomy you will need
36.224wh of storage

36,224 / 48 Volts = 754.66 ah battery capacity

SIZING-Watt Hour

15.75 kwh of daily load @48V

15,750 + 10-20% (20%) * 1.20 assumed losses

18900wh /.25 (25% DOD) = 75,600wh

For two days of autonomy you will need
75,600wh of storage

75,600 / 48 Volts = 1575 ah battery capacity

SIZING-Watt Hour LFP
Batteries

15.75 kwh of daily load @48V

$15,750 + 10-20\% (20\%) * 1.20$ assumed losses

$18900\text{wh} / .80 (80\% \text{ DOD}) = 23,625\text{wh}$

$23,625 / 48 \text{ Volts} = 492 \text{ ah battery capacity}$





What Battery Do You Choose?

"The storage battery is, in my opinion, a catchpenny, a sensation, a mechanism for swindling the public by stock companies. The storage battery is one of those peculiar things which appeals to the imagination, and no more perfect thing could be desired by stock swindlers than that very selfsame thing. ... *Just as soon as a man gets working on the secondary battery it brings out his latent capacity for lying.*"

-- Thomas Edison, *The Electrician* (London) Feb. 17, 1883

SUMMARY

Off Grid Home 1 Day of Autonomy.

This System would need 36.2kwh (754ah) of storage, using 15% losses and assuming a 50% DOD.

For Exercise Sake let's say we are going to install 16 S6-L16-HC's this would be an 890ah battery bank.

What Size Solar?

SUMMARY

Lead Based Batteries:

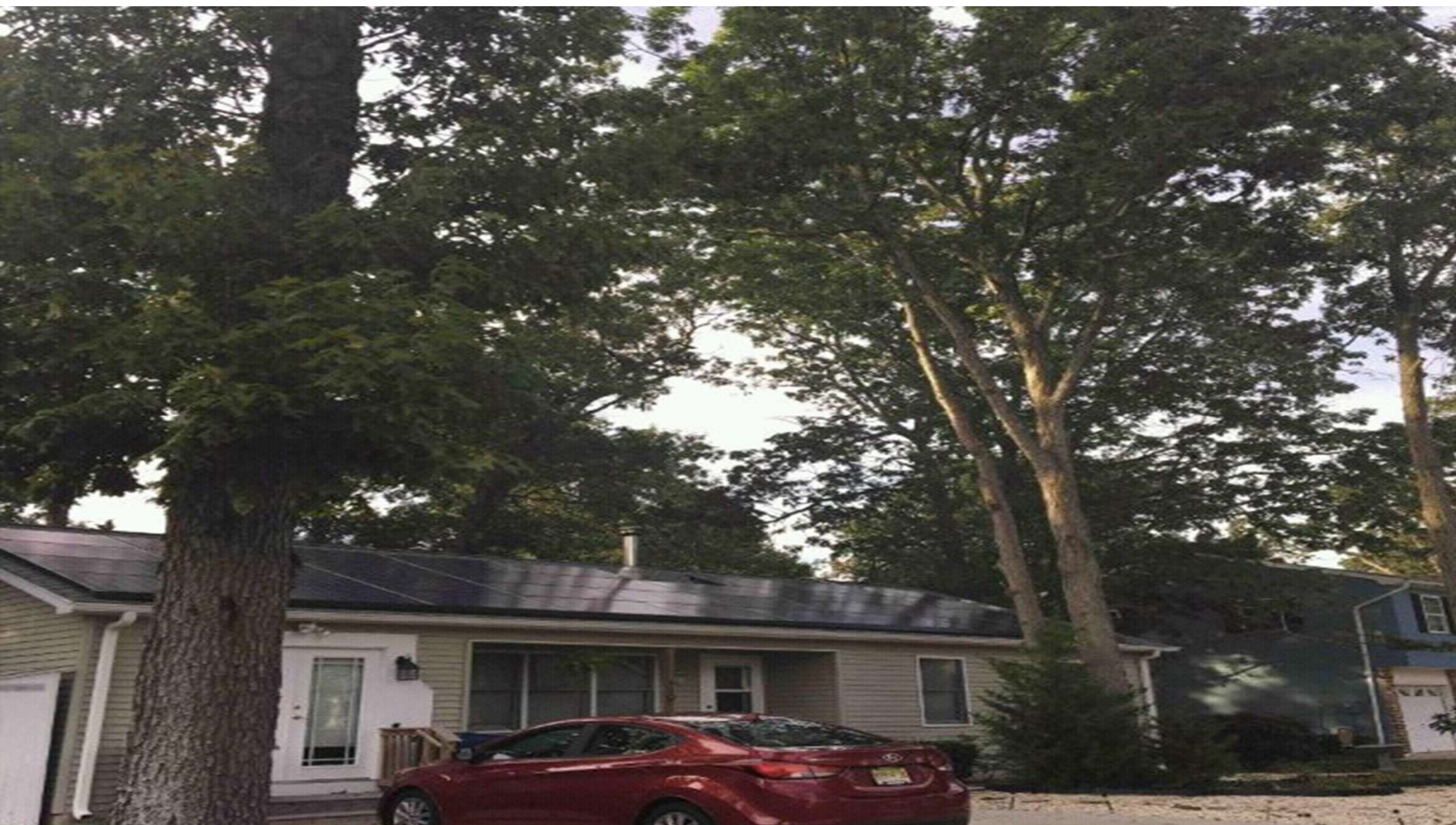
When Absorb Starts The Bank is 80% SOC.

Array (Off Grid) Should be 10-20% of Battery Bank Capacity, sweet spot is 15%.

Lithium Based Batteries

When Absorb Starts The Bank is 95 SOC.

Array (Off Grid) Should be 5-15% of Battery Bank Capacity, sweet spot is 8-10%.









Thank You!

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