OFF-GRID SOLAR POWER ESSENTIALS

KB7RHI

TOPICS FOR THIS PRESENTATION ③

- POWER YOUR RADIO WITH AN AGM BATTERY AND SOLAR
- POWER YOUR RADIO WITH AN LFP BATTERY AND SOLAR
- **POWER MANAGEMENT** WITH YOUR LARGER SIZED POWERBOX
- CASCADIA EARTHQUAKE JUST HAPPENED...THESE IDEAS COULD REALLY
 HELP

-HUGE DEMAND FOR **CORDLESS TOOLS**, WE CAN **CHARGE THE BATTERIES**

-**PHONE/USB POWERBANK CHARGING STATION**...PEOPLE WILL STILL WANT THEIR PHONE AS A CAMERA, CALCULATOR, ADDRESS BOOK, ETC

-WATER IS SO HEAVY...**12 VDC WATER TRANSFER PUMP** CAN REALLY HELP

-LETS KEEP THE LIGHTS ON, ON SCENE LIGHTS DURING THE EMERGENCY -SOLAR CHARGE YOUR BATTERY MANUALLY

YOUR POWER IS SUPPLIED BY A LEAD ACID DEEP CYCLE 55AH AGM BATTERY



POWERING YOUR RADIO WITH AN AGM BATTERY

- DEEP CYCLE 55AH AGM BATTERY
- INLINE FUSE ABOUT 6" FROM THE BATTERY...**POWERWERX** HAS THE RGH-10 WHICH IS AN EXCELLENT CHOICE
- YOU HAVE A **30 AMP FUSE** IN THE FUSE HOLDER FOR **10 AWG WIRE**
- BATTERY IS HOOKED UP DIRECTLY TO YOUR RADIO AND YOU CAN OPERATE FOR A NUMBER OF HOURS TILL THE BATTERY STATE OF CHARGE DROPS SO LOW THAT WHEN YOU TRANSMIT, THE BATTERY VOLTAGE GOES LOWER THAN WHAT YOUR RADIO NEEDS
- MANY RADIOS NEED 13.8V + OR 15% OR 11.7 VOLTS MINIMUM VOLTAGE

AFTER YOUR PORTABLE OPERATIONS, YOU PLUG IN A "BATTERY TENDER" AND CHARGE BACK UP YOUR BATTERY...YOUR THINKING, SURE WOULD BE NICE TO HAVE SOLAR POWER ⓒ



READY FOR SOLAR POWER? FOUR ITEMS YOU WILL NEED: A SOLAR PANEL, DISTRIBUTION BLOCK, CHARGE CONTROLLER AND POWER CABLE



ADD AN **INLINE POWER METER** AND YOU WILL BE BETTER ABLE TO MANAGE YOUR POWER NEEDS



BASIC SET UP FOR PORTABLE OPERATIONS WITH SOLAR POWER



YOU WANT TO SAVE SOME MONEY AND GET AN OFF-GRID **USED** SOLAR PANEL. HERE IS SOME STEPS TO TAKE TO **TEST THE PANEL** BEFORE YOU BUY IT.

- THIS EXAMPLE...USED MONOCRYSTALLINE 40 WATT SOLAR PANEL...LATE
 1990s
- USE A VOM TO CHECK THE "Voc" OR **OPEN CIRCUIT VOLTAGE**, SET THE METER TO DC AND CONNECT TO BOTH WIRES WHILE IN THE SUN
- NEXT CHECK THE "Isc" **SHORT CIRCUIT CURRENT**, COVER THE PANEL FIRST, MAKE CONNECT TO THE SOLAR PANEL WIRES, THEN EXPOSE THE PANEL TO DIRECT SUNLIGHT...OTHERWISE YOU WILL BE DOING ARC WELDING ⁽²⁾
- NOTE HOW MANY CELLS THE SOLAR PANEL HAS...AROUND 36 CELLS IS A DESIGNED AS AN OFF-GRID SOLAR PANEL
- PANELS WITH A LOT MORE CELLS ARE FOR GRID-TIE AND ARE DESIGNED FOR MPPT CHARGE CONTROLLERS THAT USE A BUILT IN TRANSFORMER TO BRING THE VOLTAGE DOWN TO THE LEVEL YOUR BATTERY NEEDS

KEEP YOUR BLACK LEAD IN THE "COM" POSITION AND MOVE YOUR RED LEAD OVER TO THE AMP POSITION, "10A" IN THIS EXAMPLE, WHEN MEASURING THE Isc



THIS IS AN EXAMPLE NAMEPLATE ON THE BACK OF A SOLAR PANEL...HOW CLOSE DOES YOUR **Voc** AND **Isc** COME TO THIS PLATE...NEED BRIGHT SUNLIGHT FOR THE ISC READING COMPARISON



MORNINGSTAR SUNGUARD **PWM** 4.5 AMP SOLAR **CHARGE CONTROLLER** FOR LEAD ACID BATTERIES ONLY...PROTECTS YOUR BATTERY FROM OVERCHARGING



INLINE POWER METER, RADIO ON RECEIVE SHOWS 0.28 AMPS, VOLTAGE 13.25v, AND 3.7 WATTS



55 AH AGM BATTERY WITH 100 WATT SOLAR PANEL USING 1ST GENERATION CUT-IN, CUT-OUT CHARGE CONTROLLER....WILL PROTECT A BATTERY...ABOUT 30% LESS EFFICIENT THAN A

PWM



"NATURE POWER" 8 AMP "ON" THEN "OFF" CHARGE CONTROLLER...1ST GENERATION EXAMPLE, DO NOT CONNECT TO A POWER SUPPLY



MORNINGSTAR **SUNSAVER-6 PWM** CHARGE CONTROLLER FOR LEAD ACID BATTERIES ONLY



MORNINGSTAR SUNSAVER-6 SOLAR CHARGE CONTROLLER...CAN BE USED WITH UP TO A 100 WATT SOLAR PANEL **FOR CHARGING LEAD ACID BATTERIES**



MC-4 CONNECTORS VERSUS ANDERSON POWER POLE CONNECTORS

- THE ANDERSON POWER POLE CONNECTOR CAN BE "HOT CONNECTED" OR DISCONNECTED ABOUT 200 TIMES
- IS IDEAL IF YOU MAKE PP CONNECTIONS WITHOUT CURRENT FLOWING
- THE MC-4 CONNECTOR IS **NOT MADE** TO BE CONNECTED OR DISCONNECTED **UNDER LOAD**. YOU WILL NEED TO SHADE YOUR PANEL WHEN CONNECTING OR DISCONNECTING WITH MC-4s

TWO DIFFERENT SIZED OFF-GRID SOLAR PANELS FOR CHARGING YOUR BATTERY

- TWO WAYS YOU CAN CHARGE YOUR BATTERY
- YOU CAN **CONNECT A SEPARATE CHARGE CONTROLLER TO EACH SOLAR PANEL** AND CONNECT TO THE DISTRIBUTION BLOCK
- EACH CONTROLLER WILL SEPARATELY ADJUST THE POWER THROUGH PUT TO YOUR BATTERY
- METHOD NUMBER 2...YOU CAN CONNECT TWO DIFFERENT, BUT SAME VOLTAGE SOLAR PANELS IN PARALLEL TO ONE CHARGE CONTROLLER THAT IS RATED FOR THE COMBINED PANEL OUTPUT
- THE AMPERAGE OF EACH PANEL WILL ADD UP AND THE VOLTAGE WILL STAY THE SAME WHEN WIRED IN PARALLEL

HERE IS A 100 WATT SOLAR PANEL AND A 40 WATT SOLAR PANEL



EACH PANEL CAN EACH HAVE THEIR OWN CHARGE CONTROLLER



CONNECTING TWO SOLAR PANELS IN PARALLEL...PLUG EACH INTO A DISTRIBUTION BLOCK, THEN CONNECT POWER CABLE TO THE CHARGE CONTROLLER



HOW MUCH SOLAR POWER CAN MY BATTERY ACCEPT?

- A NUMBER OF LEAD ACID BATTERIES **NORMALLY RECOMMEND 5% TO 10% OF THEIR RATED AMP/HOUR CAPACITY** FOR THE CHARGE CURRENT. **YOU CAN GO UP TO 20%, IN AN EMERGENCY, WOULD PROBABLY LIMIT TO 25%,** UNLESS THE BATTERY MANUFACTURER STATES OTHERWISE
- 55AH LEAD ACID BATTERY AT 20% WOULD BE 11 AMPS
- TWO 100 WATT SOLAR PANELS WITH A PWM CHARGE CONTROLLER WOULD PROVIDE ABOUT 11 AMPS...~5.5 AMPS PER PANEL
- THE 200 WATT RENOGY SOLAR SUITCASE WITH BUILT IN PWM CHARGE CONTROLLER WOULD WORK PERFECT FOR THIS TYPE OF SET UP

RENOGY 200 WATT ALL WEATHER FOLDABLE RIGID SOLAR PANEL WITH BUILT IN 20 AMP PWM CHARGE CONTROLLER...CAN BE CONNECTED DIRECTLY TO YOUR 55AH AGM BATTERY



100 WATT SOLAR PANEL EXAMPLES...ON THE LEFT IS A MONOCRYSTALLINE PANEL, ON THE RIGHT IS A POLYCRYSTALLINE SOLAR PANEL



IT WOULD BE NICE IF THEY MADE A BATTERY THAT IS EASIER FOR PORTABLE OPERATIONS?

- DO THEY MAKE A BATTERY THAT CAN SUPPORT HIGHER POWER OUTPUT FOR WHEN I WANT TO TRANSMIT AT FULL POWER?
- WHAT ABOUT A BATTERY THAT I CAN CHARGE UP MORE QUICKLY WHILE THE SUN IS SHINING, BEFORE IT GETS DARK AGAIN?
- WHAT ABOUT A BATTERY THAT IS SMALLER OR MORE LIGHT WEIGHT?
- THERE IS GOOD NEWS...THE LITHIUM IRON (Fe) PHOSPHATE OR LFP BATTERY DOES ALL OF THOSE THINGS

POWER YOUR RADIO WITH AN LFP BATTERY..LEAD ACID VERSUS LFP BATTERIES

LEAD ACID BATTERIES

- HEAVY, BUT CHEAPER IN PRICE
- CAN ACCEPT A CHARGE CURRENT OF ABOUT 20-25% OF RATED AH
- CAN OUTPUT ABOUT 20% OF RATED AH, ADD SOLAR AND MORE TOTAL POWER IS AVAILABLE
- CAN "FAST CHARGE" UP TO 80% OF SOC, THEN SLOW CHARGE FINAL 20%
- HAS A "SLOPING" DISCHARGE CURVE..VOLTAGE DROPS WITH LOWER SOC
- CAN SAFELY DISCHARGE DOWN TO ABOUT 50% OF SOC, <50% SOC CAN SHORTEN BATTERY LIFE
- MUST BE CHARGED BACK UP SOON AFTER USE OR SULFATION OCCURS
- LASTS ABOUT 500 CYCLES, ~ 3-5 YEARS

LFP BATTERIES (Lithium Fe Phosphate)

- LIGHT WEIGHT, BUT MORE EXPENSIVE
- CAN ACCEPT A CHARGE CURRENT UP TO 40% OF RATED AH
- CAN OUTPUT UP TO 100% OF RATED AH, SOME CAN EVEN EXCEED THE RATED AH AS A PEAK LOAD
- CAN "FAST CHARGE" TO NEARLY 100%
- HAS A FAIRLY "FLAT" DISCHARGE VOLTAGE CURVE
- CAN SAFELY DISCHARGE DOWN TO ALMOST 0% SOC, BMS WILL "TURN OFF" OUTPUT IF SOC = 0%
- NO SULFATION, DOES NOT NEED TO BE CHARGED BACK UP FULLY AFTER USE
- LASTS ABOUT 2,000 CYCLES
- A NUMBER ARE BACKPACK SIZED ☺

ARE YOU PLANNING TO BUY A NEW BATTERY, I WOULD RECOMMEND GETTING AN LFP BATTERY FROM BIOENNO POWER...SOME SMALLER ONES



SMALL LFP BACKPACK SIZE BATTERIES, WITH A CHARGE CONTROLLER DESIGNED FOR LFP ONLY BATTERIES...THE MPPT-150



GOOD CHOICE LFP CHARGE CONTROLLER FOR FM OPS...THE MPPT-150

- KNOW THE CHARGING AMPERAGE LIMITS OF YOUR BATTERY WHEN SIZING THE CONTROLLER
- BIOENNO BATTERIES WANT TO SEE A REGULATED CHARGING VOLTAGE OF 14.6 VOLTS AND LIMIT AMPS TO NO MORE THAN 40% OF RATED OUTPUT
- THE **MPPT-150 SOLAR CHARGE CONTROLLER** FOR LFP BATTERIES HAS A SET VOLTAGE OF 14.6 VOLTS AND CAN ACCEPT AN **INPUT VOLTAGE OF 16-25 VOLTS** AND RATED FOR **UP TO 12 AMPS MAX**
- SINGLE SOLAR PANEL, OR SOLAR PANELS WIRED IN PARALLEL ONLY
- DOES CREATE RF NOISE IF YOU ARE DOING HF RADIO, I AM NOT SEEING ANY RF NOISE ON VHF/UHF FM...PERFECT FOR LOCAL OPS
- EASILY FITS IN A BACKPACK

IF DOING HF RADIO, YOU WILL WANT A MORE RF QUIET MPPT CHARGE CONTROLLER LIKE THE **GENASUN** OR **DIYSOLAR4U** CHARGE CONTROLLER



DIY SOLAR FOR U "SOL" 20 AMP MPPT CHARGE CONTROLLER...BY DESIGN IS MADE TO BE MORE RF QUIET



WHY USE AN MPPT CHARGE CONTROLLER?

- MAXIMUM POWER POINT TRACKING "MPPT" CHARGE CONTROLLERS HAVE A BUILT IN TRANSFORMER THAT CONVERTS HIGHER SOLAR PANEL INPUT VOLTAGE DOWN TO LOWER BATTERY CHARGING VOLTAGE
- WITH MPPT...**POWER IN = POWER OUT**...THE PERCENTAGE THAT THE CHARGE CONTROLLER TRANSFORMER **REDUCES THE SOLAR PANEL VOLTAGE DOWN** TO BATTERY VOLTAGE, IS THE SAME PERCENTAGE THAT THE TRANSFORMER **INCREASES THE AMPERAGE OUTPUT** OF THE CHARGE CONTROLLER
- THE MPPT CONVERTS DC TO AC VOLTAGE, ADJUSTS THE VOLTAGE DOWN TO THE BATTERY VOLTAGE AND CONVERTS BACK TO DC

WHEN SETTING UP THE LFP BATTERY, BEST PRACTICE IS TO HAVE AN INLINE FUSE CLOSE TO THE BATTERY...ATC STYLE FUSE HOLDER WITH PP CONNECTORS...**POWERWERX "PPH-10**"



BACKPACK SIZED SOLAR PANEL AND BATTERY...BIOENNO POWER "**BSP-28**" SOLAR PANEL



BIOENNO POWER 28 WATT FOLDABLE SOLAR PANEL WITH ONE USB OUTPUT AND 12V OUTPUT


BIOENNO POWER **BSP-60-LITE** PORTABLE SOLAR PANEL READY TO BE CONNECTED WITH **GENASUN GV-5 MPPT** CHARGE CONTROLLER



BIOENNO POWER BSP-60-LITE SOLAR PANEL WITH THE CABLE ACCESS POCKET OPENED UP, THE POCKETS CAN HOLD POWER CABLE AND CC



BIOENNO POWER **BSP-60-LITE** FOLDABLE SOLAR PANEL HAS BUILT IN SUPPORT LEGS



POWERWERX FSP-60 PORTABLE SOLAR PANEL, HAS A MAGNETIC CLOSE



FSP-60 SIDE VIEW WITH FOLDING LEGS



THE PERFECT COMBO FOR YOUR 30AH LFP BATTERY...THE **BSP-150-LITE** FOLDABLE SOLAR PANEL AND THE **MPPT-150** CHARGE CONTROLLER



CAUTION...THE FOLDABLE DRY WEATHER SOLAR PANELS CAN GET **VERY HOT** IN DIRECT SUN...LET THEM COOL DOWN A MOMENT BEFORE YOU FOLD THEM BACK UP OR THIS COULD HAPPEN



BIOENNO POWER LFP BATTERY MAX CONTINOUS DISCHARGE CURRENT AND MAX CHARGING CURRENT INFO

LFP BATTERY SIZE	MAX CONTINOUS <u>DISCHARGE</u> CURRENTIS BMS DEPENDENT	MAX <u>CHARGING</u> CURRENT40% OF THE RATED LFP AH
6AH	12 AMPS	2.4 AMPS
9AH	12 AMPS	3.6 AMPS
12AH	20 AMPSNOT FOR HIGH PWR HF	4.8 AMPS
20AH	40 AMPSOK FOR HIGH PWR HF 🙂	8.0 AMPS
30AH	30 AMPS	12 AMPS
40AH	40 AMPS	16 AMPS
50AH	50 AMPS	20 AMPS

SOLAR PANEL SIZING IN FULL SUN WITH YOUR BIOENNO LFP BATTERY USING AN **MPPT CC**

LFP BATTERY SIZE	MAX <u>CHARGING INPUT</u> AMPS	MAX NAME PLATE SOLAR PANEL WITH <u>MPPT CC ATTACHED</u>
6AH	2.4 AMPS	35 WATTS
9AH	3.6 AMPS	50 WATTS
12AH	4.8 AMPS	70 WATTS
20AH	8.0 AMPS	110 WATTS
30AH	12.0 AMPS	170 WATTS
40AH	16.0 AMPS	225 WATTS
50AH	20.0 AMPS	280 WATTS
70AH	28.0 AMPS	400 WATTS
100AH	40.0 AMPS	575 WATTS

LARGER LFP BATTERIES ARE BEST PLACED IN A POWER BOX...POWERWERX MEGABOX, PWRBOX, AND POWER BOX-20, AND IMPULSE ELECTRONICS MITY-T300 GO-BOX



20AH POWER BOX BEING CHARGED BY TWO SOLAR PANELS IN **PARALLEL**...CONNECT YOUR RADIO TO THE DISTRIBUTION BLOCK AND ENJOY



DOUBLE YOUR JOY AND **CONNECT TWO POWER BOXES TOGETHER** IF SAME SOC AND SAME BATTERY SIZE AND AGE



POWERWERX PWRBOX WITH 30 AH LFP BATTERY, BEING CHARGED BY 100 WATT SOLAR PANEL AND **MPPT-150** CHARGE CONTROLLER



I CONNECTED MY RADIO WITH BATTERY TO SOLAR POWER AND MY INLINE METER ONLY SHOWS A TINY AMOUNT OF POWER COMING FROM MY SOLAR PANEL?

- THERE IS NO PROBLEM, YOUR BATTERY IS FULL AND THERE IS NO WHERE ELSE FOR THE ELECTRONS TO GO, EXCEPT TO SUPPLY THE RADIO...YOUR INLINE METER MIGHT READ 0.28 AMPS WHILE THE SOLAR PANEL IS IN FULL SUN...PUSH TO TALK WITH THE MIC AND WATCH THE SOLAR AMPS JUMP BACK UP
- IF YOU ARE IN AN EMERGENCY, TRY TO **FIND SOME USB POWERBANKS** TO CHARGE UP TO HARVEST AS MUCH POWER AS POSSIBLE WHEN YOUR PRIMARY BATTERY IS FULL

I WANTED TO SEE HOW MANY AMPS MY NEW SOLAR PANEL PUTS OUT, CONNECTED IT TO MY BATTERY AND HARDLY ANY AMPS ARE SEEN ON THE INLINE METER?

- YOU MAY BE TRYING TO TEST THE OUTPUT OF THE SOLAR PANEL CONNECTED TO A FULL BATTERY, NO WHERE FOR THE ELECTRONS TO GO...TRY ADDING A GOOD SIZED LOAD TO THE SET UP, THEN TEST THE HOW MANY AMPS YOU GET FROM SOLAR
- WHEN CONNECTED TO SOLAR POWER, SOLAR "AMPS" GO TO THE LOAD FIRST, THEN EXCESS AMPS CHARGE YOUR BATTERY

PWRBOX BEING CHARGED WITH MORE RF QUIET **GENASUN GV-10** CHARGE CONTROLLER



MEGABOX BEING CHARGED WITH 100 WATT SOLAR PANEL USING A VICTRON SMART SOLAR 100/30 MPPT CHARGE CONTROLLER WITH BT



MEGABOX BEING CHARGED BY POWERWERX FSP-300 WATT FOLDABLE SOLAR PANEL AND MORE HF QUIET DIYSOLAR4U "SOL" MPPT CHARGE CONTROLLER



MEGABOX BEING CHARGED WITH POWERWERX FSP-300 WATT FOLDABLE SOLAR PANEL AND VICTRON SMART SOLAR 30 AMP MPPT CC



MPPT ILLUSTRATION USING TWO 100 WATT SOLAR PANELS AND A VICTRON SMARTSOLAR CHARGE CONTROLLER **CONNECTED IN SERIES**



TWO 100 WATT SOLAR PANELS CONNECTED IN SERIES, THIS PIC SHOWS THE "Voc" OR OPEN CIRCUIT VOLTAGE...**NO LOAD CONNECTED YET**



MPPT CHARGE CONTROLLER NOTE

- WHEN CONNECTING TWO SOLAR PANELS IN SERIES AND USING AN MPPT CHARGE CONTROLLER...USE THE SAME SOLAR PANEL WATTAGE SIZE AND VOLTAGE
- PREVIOUS PIC SHOWED A RENOGY 100 WATT MONOCRYSTALLINE SOLAR PANEL AND A 100 WATT POLYCRYSTALLINE SOLAR PANEL, THIS CAN IMPACT YOUR MPPT POINTS THAT THE CC IS LOOKING FOR
- POLYCRYSTALLINE PANELS ARE SLIGHTLY LESS EFFICIENT AND THE VOLTAGE
 OUTPUTS FROM BOTH PANELS COULD BE SLIGHTLY DIFFERENT
- CONNECTING TWO DIFFERENT TYPE 100 WATT PANELS IS OK, BUT THE POWER OUTPUT WILL BE SLIGHTLY LESS THAN IF BOTH PANELS WERE THE SAME
- CONNECTING SOLAR PANELS IN PARALLEL, THE PANELS CAN BE DIFFERENT FOR THE PWM CC

SCREEN SHOT OF "VICTRON SMARTSOLAR" CC WITH TWO 100 WATT SOLAR PANELS CONNECTED IN **SERIES**...NOTE SOLAR SIDE AND BATTERY SIDE VALUES...SOLAR INPUT VOLTAGE WENT FROM

42.1v TO 33.43v HAS BEGUN



BATTERY CHARGING

IMPULSE ELECTRONICS MITY GO-BOX WITH 20AH BATTERY, BUILT IN FUSE AND DC ACCESS PORTS



LOOK INSIDE THE MITY GO-BOX POWERBOX, NOTE SPACE FOR ACCESSORIES



MITY GO-BOX DC ACCESS PORTS



20AH LFP POWER BOX IS THE MOST IDEAL SIZE TO OWN, POWERWERX HAS INTRODUCED THEIR 20AH LFP POWERBOX RECENTLY



POWERWERX PWRBOX-20 LOOK INSIDE, STILL HAS SOME ROOM TO PUT SOME ITEMS



POWERWERX PWRBOX-20 WITH BUILT IN LIGHT ON



DC ACCESS PORTS ON THE PWRBOX-20



HOW MUCH POWER ARE YOU GETTING FROM THE SUN? HOW MUCH POWER ARE YOU USING?

- HOW DO YOU DO **POWER MANAGEMENT**?
- HOW DO YOU KNOW YOUR **BATTERY SOC**?
- IF YOU USE AN INLINE POWER METER, YOU WILL NEED ONE TO SHOW POWER OUTPUT TO THE LOAD AND SOLAR INPUT TO THE SYSTEM TO HAVE THE BEST VIEW OF YOUR POWER SITUATION
- POWERBOXS CAN GREATLY SIMPLIFY YOUR STATION SET UP, BUT THEY HAVE **MULTIPLE DC ACCESS PORTS**, CAN BE DIFFICULT TO ESTIMATE POWER USAGE?

POWERWERX PWRBOX, OLDER MODEL



THE POWERWERX NEW EDITION OF THE "PWRBOX" HAS A VOLTAGE BASED **SOC METER**. PER POWERWERX, SOC ON LFP BATTERIES ALIGNS WITH THE FOLLOWING VOLTAGES

Percentage	<u>Voltage</u>
100%	13.30
90%	13.20
80%	13.18
70%	13.16
60%	13.14
50%	13.11
40%	13.07
30%	13.04
20%	12.98
10%	12.82
5%	12.62
0%	11.20

LFP BATTERIES HAVE A FAIRLY FLAT DISCHARGE CURVE, UNLIKE A LEAD ACID BATTERY WITH A STEEP DISCHARGE CURVE

- THE TABLE ON THE PREVIOUS PAGE SUGGESTS A CORRELATION BETWEEN VOLTAGE AND SOC
- I HAVE NOT TESTED THIS PERSONALLY
- IN MY READING, THE TRADITIONAL SCHOOL OF THOUGHT IS BECAUSE THE LFP DISCHARGE CURVE IS SO FLAT, IT IS CONSIDERED DIFFICULT TO EVALUATE SOC BASED SOLELY ON VOLTAGE
- WILL BE INTERESTED IN HEARING FEEDBACK ON HOW THIS METER IS WORKING

THE **BEST WAY** TO DO POWER MANAGEMENT IS WITH A **SHUNT** PLACED BETWEEN THE BATTERY AND ALL LOADS

- THE **POWERWERX MEGABOX** AND THE **POWERWERX PWRBOX** CAN ACCEPT A VICTRON SHUNT AND IT USES BLUETOOTH TO CONNECT TO A "VICTRON CONNECT" APP ON YOUR PHONE...IT SHOWS:
- STATE OF CHARGE____%
- VOLTAGE OF THE BATTERY_____VOLTS
- CURRENT GOING INTO OR OUT OF YOUR BATTERY_____AMPS
- POWER IN WATTS____WATTS
- CONSUMED AH____AH
- TIME REMAINING WITH THE LOAD, YOU CAN SET THE "TIME-TO-GO AVERAGING PERIOD...IE 3 MINUTES

EXAMPLE OF A SCREEN SHOT OF THE "VICTRON SMARTSHUNT"...NO SOLAR INPUT, JUST SHOWING A CONSTANT LOAD USING A 400 WATT INVERTER RUNNING A BOX FAN


VICTRON SHUNT WIRED FOR PLACEMENT IN A POWERWERX PWRBOX, NARROW CONFIGURATION



NOTE THE PIC ON THE PREVIOUS SLIDE...POWERWERX PWRBOX WIRING FOR THE VICTRON SHUNT

- USING 8 AWG WIRE I CUT **7" OF RED WIRE**. CRIMP AN 8AWG CONTACT ON EACH END AND CONNECT EACH END INTO YOUR TWO SB-50 PP GREY HOUSINGS
- CUT AN 8AWG BLACK WIRE TO 11", THIS IS FOR THE BATTERY TO SHUNT CONNECTION...HAS TO FORM A LOOP AWAY AND BACK FROM THE SHUNT TO MAKE A CONNECTION THE BATTERY GREY PP.
- PUT A CONTACT ON ONE END AND A 3/8" LUG ON THE OTHER END, THIS WIRE GOES FROM THE BATTERY PP SB-50 TO THE SHUNT
- CUT A 9" BLACK WIRE FOR THE SYSTEM PP SB-50 TO SHUNT CONNECTION. ONE END WILL HAVE THE CONTACT, THE OTHER END WILL HAVE THE 3/8" LUG FOR CONNECTION TO THE SHUNT
- THE **SMALL RED WIRE** FROM THE SHUNT, CUT OFF THE RING TERMINAL AND REPLACE WITH 15 AMP PP CONNECTOR, THIS ONE PP WILL THEN CONNECT TO THE OTHER POWER WIRE FROM THE BATTERY

"VICTRON" **SHUNT** WIRED FOR PLACEMENT IN A POWERWERX **MEGABOX**, **WIDE CONFIGURATION**



HOW TO DIY YOUR "VICTRON SMARTSHUNT" 500A/50mV TO CONNECT TO YOUR **MEGABOX**

- USING 8 GAUGE WIRE, CUT ABOUT 7" OF THE RED WIRE AND CONNECT EACH END TO THE POSITIVE TERMINAL OF TWO SB50 ANDERSON POWER POLE CONNECTORS
- NEXT CUT TWO SECTIONS OF BLACK 8 GAUGE WIRE TO ABOUT 5.0"
- CONNECT ONE END EACH TO THE NEGATIVE TERMINAL OF AN SB50 PP
- ON THE OTHER END, ATTACH A 3/8" LUG FOR CONNECTION TO THE VICTRON SHUNT
- THE VICTRON SHUNT MEASURES POWER THROUGHPUT VIA THE BLACK NEGATIVE WIRE CONNECTIONS
- THE SMALL RED POWER WIRE CONNECTS TO "BATT +" TERMINAL ON THE SHUNT... REMOVE THE RING TERMINAL AND REPLACE WITH A RED 15A PP...CONNECT THAT TO THE SECOND PP CABLE COMING FROM YOUR BIOENNO POWER LFP BATTERY TO TURN ON THE SHUNT

THE PP(ANDERSON POWER POLE) CONNECTOR COLORS MAKES A DIFFERENCE

- DO NOT GET OTHER SB-50 PP COLORED CONNECTORS, THEY ARE DESIGNED TO JUST MATCH WITH THE SAME COLOR. THE BLACK AND GREY ARE THE ONLY EXCEPTIONS
- THE BIOENNO POWER SB-50 PP CONNECTIONS ARE ALL GREY IN COLOR

POWERWERX HAS THE SHUNT I FOUND THAT WORKS BEST

- Victron Energy SHU<u>050</u>150050 SmartShunt 500A/50mV
- NOT THE SHU<u>065</u>150050...THAT IS THE MARINE GRADE ONE AND IS NOT AS EASY TO INSTALL IN THE MEGABOX OR THE POWERBOX
- THE MARINE GRADE ONE HAS TWO EXTRA WIRES THAT ARE NOT NEEDED AND THE RED POWER WIRE IS ATTACHED AT THE OPPOSITE END OF SHUNT, THE SHU050...SHUNT "BATT+ RED WIRE EASILY CONNECTS ON THE SHUNT WHILE IN THE BOX
- PLAN TO PUT A VELCRO STRIP DOWN IN THE MEGABOX, OR PWRBOX TO HELP SECURE IT IN PLACE

ONCE THE SHUNT IS INSTALLED

- DOWNLOAD THE VICTRON CONNECT APP
- TURN ON BT ON YOUR PHONE
- CONNECT THE SHUNT SB-50 GREY PP CONNECTIONS AND THE 15AMP PP RED CONNECTION TO THE PP CABLE ALSO COMING FROM YOUR BIOENNO BATTERY
- YOU WILL SEE A BLUE FLASHING LIGHT IN FRONT OF THE SHUNT COME ON
- OPEN THE VICTRON APP AND CONNECT TO THE SHUNT
- IT WILL ASK FOR A 6 DIGIT CONNECTION CODE...DEFAULT IS SIX ZEROS AT FIRST...YOU CAN CHANGE IT AT THIS TIME...WRITE DOWN YOUR SIX NUMBERS...WILL NEED THEM IF MORE THAN ONE PHONE IS TO MAKE A CONNECTION
- IT WILL ASK TO MAKE ANY SOFTWARE UPDATES...GOOD TIME TO MAKE UPDATES

SETTINGS FOR THE VICTRON SHUNT PAGE 1

- MAIN PAGE ON THE VICTRON APP... UPPER RIGHT IS A "GEAR" SYMBOL
- GO TO BATTERY, OR GO TO BATTERY RIGHT AWAY IF JUST STARTING
- SET BATTERY CAPACITY...70AH...FOR MY 70AH LFP BATTERY
- CHARGED VOLTAGE = 14.6
- DISCHARGE FLOOR = HOW LOW DO YOU WANT TO RUN DOWN THE BATTERY, I SET TO 0%...WILL SHOW STATE OF CHARGE THEN DOWN TO ZERO, WANT YOUR SOC TO JUST SHOW TOP 80%, SET TO 20%
- TAIL CURRENT = 4.00%
- CHARGED DETECTION TIME (DEFAULT) TO 3M
- PEUKERT EXPONENT = 1.05

SETTINGS FOR THE VICTRON SHUNT PAGE 2

- CHARGE EFFICIENCY FACTOR = 99%
- CURRENT THRESHOLD = 0.10 AMPS
- TIME AVERAGING = 3 MINUTES, THIS SETTIN WILL SHOW YOUR TIME LEFT TO GO BASED ON YOUR AVERAGE USAGE OVER THE LAST 3 MINUTES...YOU CAN SET TO WHATEVER YOU WANT
- BATTERY SOC ON RESET = KEEP SOC...THIS IS IMPORTANT, IF YOU DISCONNECT THE SHUNT AND THEN RECONNECT IT, THE SOC INFO WILL NOT CHANGE
- SYNCHRONIZE SOC TO 100%...HIT THE BLUE "SYNCHRONIZE" BUTTON ONCE THE BATTERY IS FULL, THE SHUNT WILL NOW BE SYNCHRONIZED TO THE CURRENT BATTERY SOC
- THESE ARE THE SETTINGS I USE FOR MY 70AH LFP BATTERY

MEGABOX IS WIDER THAN THE PWRBOX



POWERWERX MEGABOX WITH 70 AH LFP BATTERY AND VICTRON **SHUNT**



THE SMALL VICTRON SHUNT RED WIRE GIVES POWER TO THE SHUNT FOR BT USE...CONNECT THE WIRE TO THE OTHER POWER CABLE COMING FROM YOUR LFP BATTERY



YOU CAN STILL PUT A NUMBER OF ITEMS IN YOUR MEGABOX WITH THE SHUNT IN PLACE



"PWRBOX" WITH A SOLAR PANEL POWER CABLE, CC, DISTRIBUTION BLOCKS, INLINE METER, EXTRA FUSE, HEADLAMP, PHONE CHARGING CABLE, USB CAR ADAPTER



PNW IS PREPARING FOR THE CASCADIA SUBDUCTION ZONE EARTHQUAKE

- FEMA CASCADIA EARTHQUAKE EXERCISE SCENARIO INFORMATION LINK FROM 2015...**EXCELLENT DOCUMENT** SHOWING PREDICTED IMPACTS TO WASHINGTON AND OREGON
- https://www.oregon.gov/oem/Documents/Cascadia_Rising_Exercise_ Scenario.pdf

<u>Fuel will be a problem...generators do not help without fuel</u> <u>Quakehttps://www.opb.org/news/series/unprepared/oregon-</u> <u>earthquake-fuel-breakdown-90-percent/ Could Threaten 90 Percent</u> <u>Of Oregon Fuel Supply – OPB</u>

WHAT IF THE CASCADIA EARTHQUAKE JUST HAPPENED? THE SUPPLY CHAIN WILL BE BROKEN

- BESIDES RADIO COMMS, THESE IDEAS MAY ALSO BE A BIG HELP AFTER A MAJOR EARTHQUAKE
- -CHARGE CORDLESS TOOL BATTERIES, PORTABLE POWER TOOLS WILL BE PRICELESS
- -SET UP A PORTABLE (PHONE/USB POWERBANK) CHARGING STATION
- -USE A 12 VOLT DC DIAPHRAGM WATER PUMP TO TRANSFER WATER, DOES NOT NEED TO BE PRIMED, CAN TRANSFER WATER INTO AN RV, ETC
- -PROVIDE AFTER HOURS ON SCENE EMERGENCY LIGHT DURING RESCUE OPERATIONS, OR JUST SOME PROVIDE LIGHT TO A LOCATION IN THE DARK
- -THERE COULD BE CAR/TRUCK BATTERIES THAT BECOME AVAILABLE, BUT NEED TO BE CHARGED...VERY HEAVY TO MOVE, ARRANGE TO SET UP CHARGING STATIONS WITH THEM, JUST DO NOT DEEP DISCHARGE THEM
 ③

THE ABILITY TO CHARGE CORDLESS TOOL BATTERIES IN A GRID DOWN SITUATION IS VERY HELPFUL...DEWALT DCB-119 "CAR CHARGER"



PUT AN INLINE DC METER WHILE USING YOUR DC TO DC CHARGER FOR CORDLESS TOOL BATTERIES TO SEE YOUR POWER USAGE



HEAVY LEAD ACID BATTERIES CAN BE CHARGED IN PLACE, THEN USE A **DC TO DC CHARGER** FOR **LFP BATTERIES**, OR **CHARGE** LFP BATTERY **WHILE DRIVING**



AUTOMOTIVE 12 VOLT TO 14.6 VOLT LITHIUM BATTERY CHARGER

- YOU CAN CHARGE YOUR LFP BATTERIES WHILE IN YOUR CAR
- INPUT VOLTAGE IS 8 VDC TO 36 VDC
- POST EARTHQUAKE, CAR BATTERIES MAY BE AVAILABLE, BUT HEAVY TO MOVE AROUND...SET THEM UP IN A LOCATION TO BE SOLAR CHARGED...THEN BRING LIGHTER WEIGHT PORTABLE LFP BATTERIES TO BE CHARGED AS NEEDED WHEN NOT IN USE
- THIS CHARGER WILL ALLOW YOU TO CHARGE YOUR LFP BATTERY FROM ANY OTHER BATTERY WITH A VOLTAGE RANGE FROM 8VDC TO 36VDC
- CAN ALSO BE A BACKUP SOLAR CHARGE CONTROLLER, SO LONG AS THE SOLAR OUTPUT CAN MEET OR EXCEED THE DC TO DC CHARGER SETTING INPUT NEEDS
- REGULATED OUTPUT AND 2 AMP, 4 AMP, AND 8 AMP OUTPUT SETTINGS

IMPULSE ELECTRONICS HAS A DC TO DC CHARGER FOR LFP BATTERIES, ADJUSTABLE POWER OUTPUT



DC TO DC CAR CHARGER FOR LFP BATTERIES BEING USED WITH A REGULAR 13.8 VOLT POWER SUPPLY



PHONE/USB POWERBANK CHARGING STATION USING A PWRBOX WITH 30AH BATTERY, USE A DISTRIBUTION BLOCK TO CONNECT SEVERAL USB CHARGERS



ON SCENE LIGHTING...1.5 MILLION CANDLE POWER 12V SPOTLIGHT, EGO 10,000 LUMEN LIGHT, LIGHTHOUSE MINI, AND DEWALT 12V/20V LITHIUM LIGHT



1.5 MILLION CANDLE POWER SPOTLIGHT USES 6.7 AMPS...WITH THIS PWRBOX YOU CAN USE FOR ALMOST 3 HOURS ON SCENE, CAN BE CARRIED PORTABLE OR JUST USE THE BUILT IN TRIPOD



10,000 LUMEN EGO 56 VOLT ADJUSTABLE LIGHT, WE CAN RECHARGE THE BATTERIES



EGO LIGHT FOLDED UP AND READY FOR TRANSPORT, JUST ADD THE BATTERY



"EGO POWER" 210 WATT AC BATTERY CHARGER SPECS, JUST NEED AN INVERTER THAT CAN OUTPUT 210 WATTS CONTINOUSLY



"EGO POWER" ALSO MAKES A 320 WATT AC BATTERY CHARGER...MODEL CH3200



SOME INVERTERS MAKE CLAIMS THAT THEIR INVERTER IS BETTER THAN OTHERS

- THE "WAGAN" 400 WATT ELITE INVERTER MAKES A CLAIM THAT OTHER INVERTERS ARE NOT REALLY ABLE TO OUTPUT THEIR STATED WATTAGE
- THEY CLAIM THEIR INVERTER CAN PROVIDE 400 WATTS CONTINOUSLY
- WELL...LETS PUT THAT CLAIM TO THE TEST AND SEE WHAT HAPPENS?

WATCH OUT...30AH PWRBOX WITH **400 WATT DC TO AC INVERTER**, 210 WATT 56 DC VOLT BATTERY CHARGER...INVERTER WHILE CHARGING ONLY LASTED 6 MINUTES AND THEN **FAULTED** ⁽²⁾



30AH LFP BATTERY, "WAGAN PURELINE" 700 WATT INVERTER, 210 WATT AC BATTERY CHARGER WITH 56 VOLT, 10AH BATTERY CHARGING, THIS SIZE INVERTER DID JUST FINE



HAVE TWO POWER LEGS ON YOUR INVERTER, ONE CONNECTION TO SOLAR POWER AND THE OTHER LEG TO YOUR BATTERY...GET A SOLAR BOOST



30AH LFP BATTERY CHARGING 56 VOLT 10AH BATTERY USING 210 WATT AC CHARGER, **IF SOLAR ADDED**, LESS OUTPUT NEED WITH YOUR BATTERY



300 WATT DC TO AC INVERTER FROM IMPULSE ELECTRONICS



SMALL INVERTERS THAT USE AN AUTOMOTIVE PLUG-IN...MOST ARE OK FOR 120 TO 180 WATTS MAX...GOOD FOR CHARGING BASIC LAPTOPS, ETC


MANUAL CHARGING OF A BATTERY WITH A SOLAR PANEL

- WILL DISCUSS DETAILS IN PRESENTATION
- BATTERIES ARE EXPENSIVE, DO NOT WANT SOMEONE TO MISUNDERSTAND THE STEPS ③

AMATEUR RADIO OPERATORS CAN BE KNOWN FOR THREE THINGS

- WE ARE **FREQUENCY AGILE**, NOT LIMITED TO JUST MEMORY CHANNELS
- WE ARE **LOCATION AGILE**, ABLE TO SET UP PORTABLE OPS
- WE CAN BE **POWER AGILE** ③
- BE GOOD TO YOUR ELECTRONS AND THEY WILL POWER MANY THINGS FOR YOU ☺