# POWER

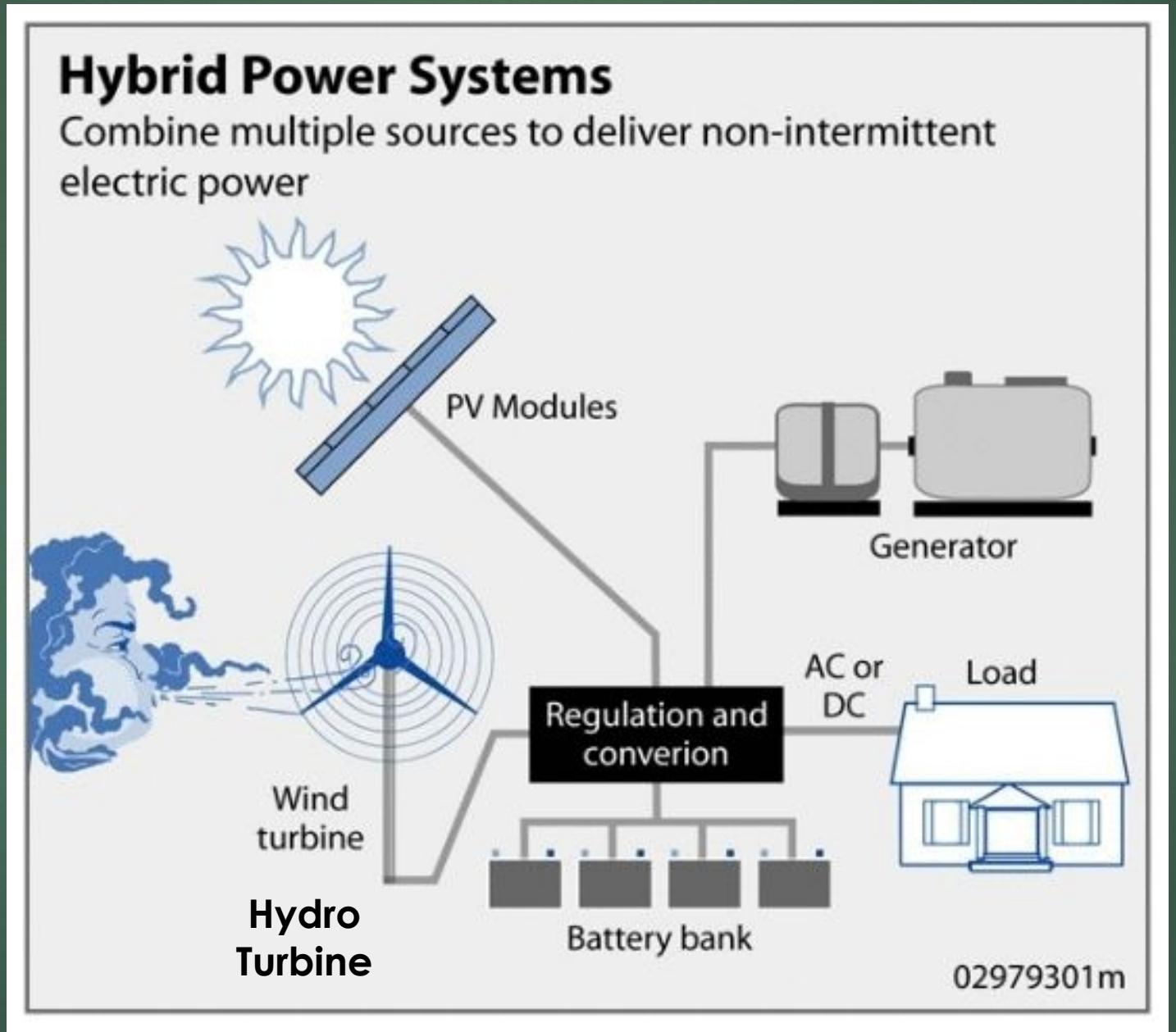
- WHY DO WE USE RENEWABLE ENERGY TO RUN THE LODGE?
- WHY IS IT IMPORTANT?

# POWER
# Why Use Renewables?

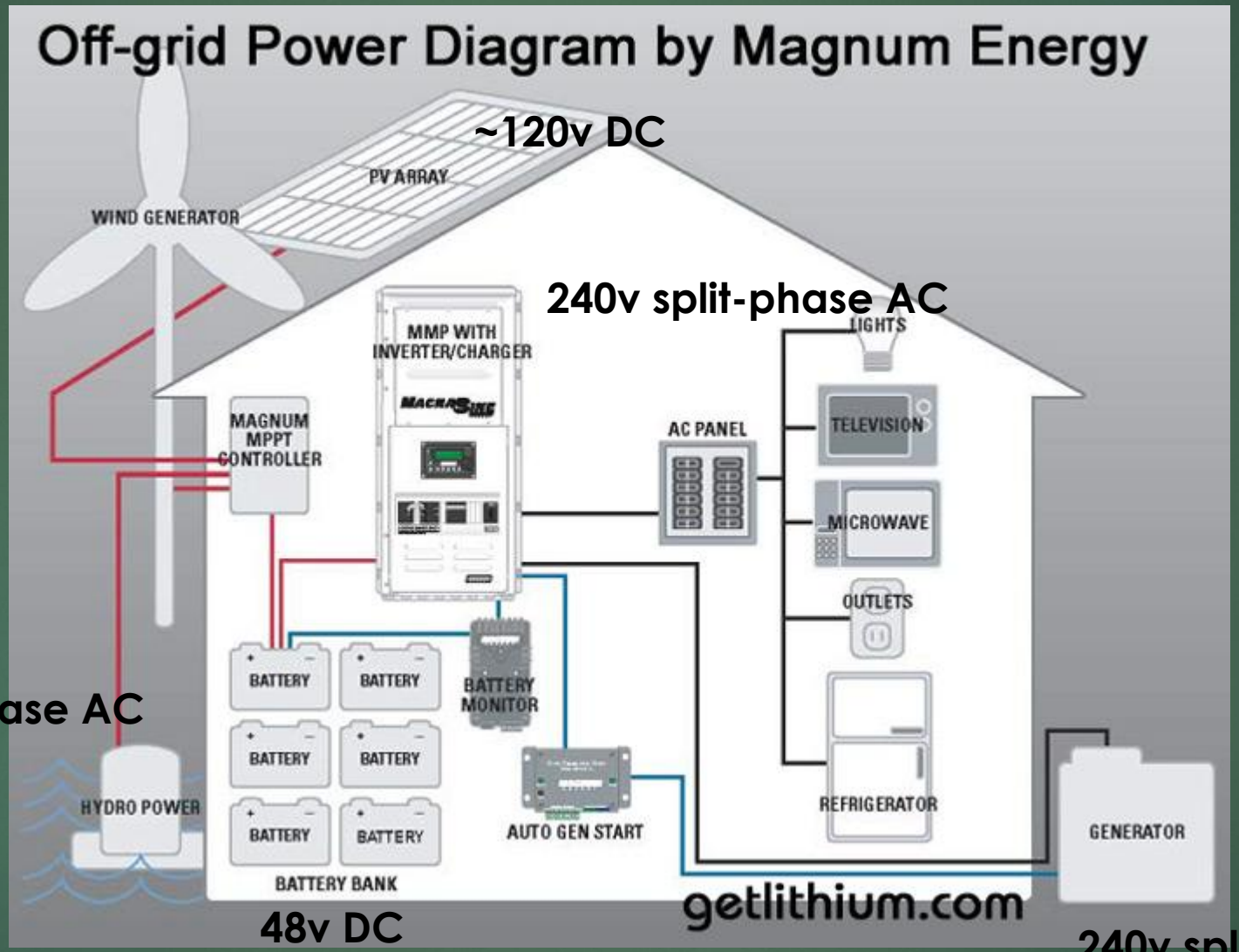
- REDUCE OUR CONTRIBUTION TO CLIMATE CHANGE
  - REDUCING CARBON EMISSIONS INTO THE ATMOSPHERE
  - PARTICULARLY IMPORTANT FOR BELIZE – WHY?
- PUBLIC HEALTH – REDUCE POLLUTION
- OPERATE IN A SUSTAINABLE MANNER, WHERE WE CAN
- SERVE AS A MODEL FOR OTHER LODGES/BUSINESSES

# GENERAL SET-UP OF OFF-GRID HYBRID POWER SYSTEMS

- PRODUCTION
  - SOLAR
  - HYDRO
  - GENERATOR
- CONTROLS
- STORAGE
- LOAD



# LOTS OF DIFFERENT VOLTAGES AND CURRENTS AND PHASES




48v DC
&
480v 3-phase AC


MAGNASINE

# Solar Power

- 4 Arrays
  - Large - Tall – 3000 watts ~120v DC
    - 4 panels in series, 3 sets of 4 panels in parallel
  - Small – Tall – 2000 watts ~ 120v DC
    - 4 panels in series, 2 sets in parallel
  - 2 short Arrays – 1620 watts ~ 100v DC
    - 6 panels in series, 2 sets in parallel

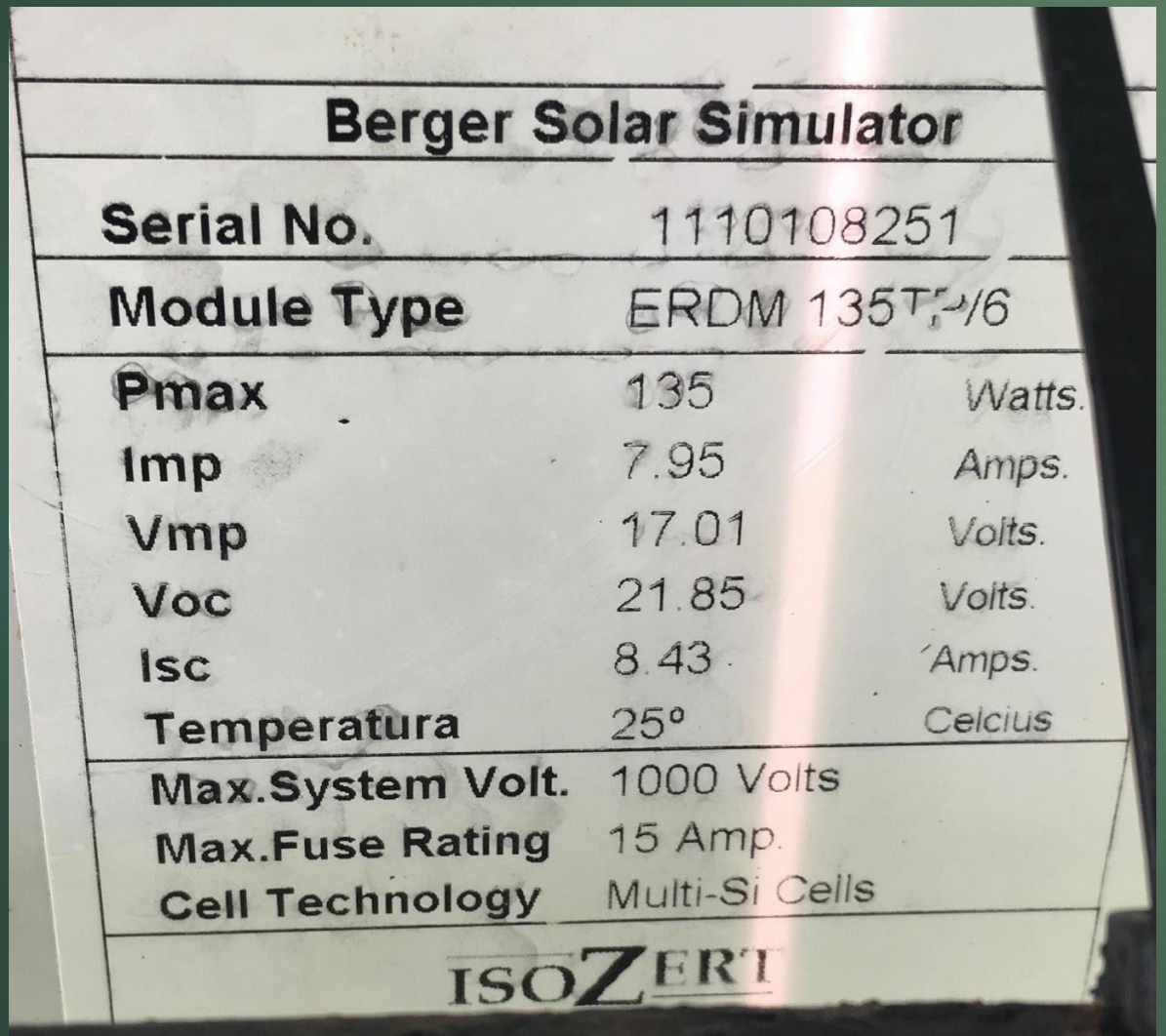
# Solar Power

- Power needs to be converted to Battery Voltage by the Charge Controllers
  - Prevent losses in power at night
  - Prevent overcharging
  - Maximize Power production – Get most power possible out of batteries

# Solar Power

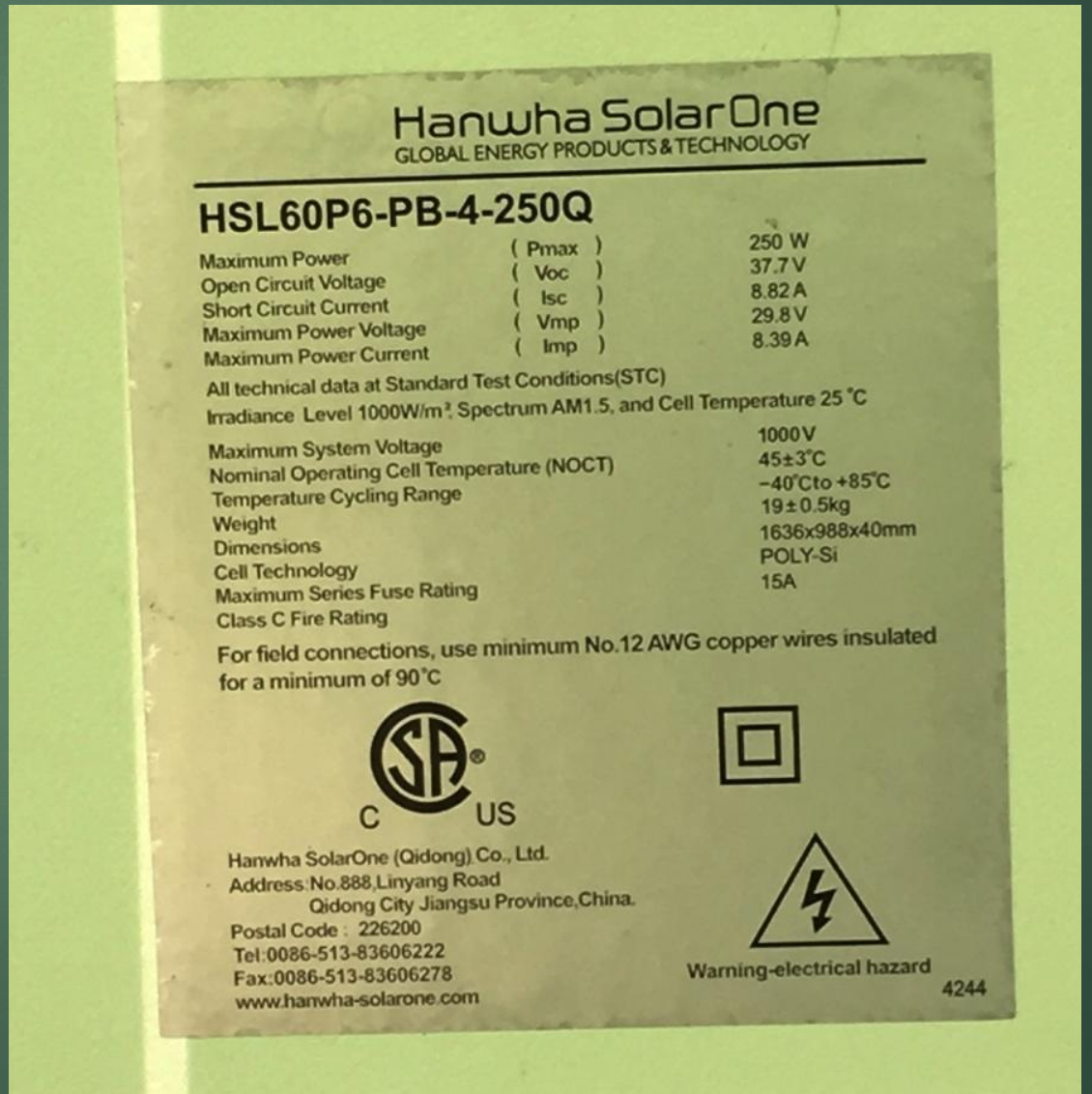
- Electricity enters at High voltage DC
- Electricity is converted to battery voltage – lower voltage at a higher current.
- Controller gives lots of information
  - Instantaneous power
  - Power produced

# Solar Power



| Berger Solar Simulator | | |
|---|---|---|
| Serial No. | 1110108251 | |
| Module Type | ERDM 135T[illegible]/6 | |
| Pmax | 135 | Watts. |
| Imp | 7.95 | Amps. |
| Vmp | 17.01 | Volts. |
| Voc | 21.85 | Volts. |
| Isc | 8.43 | Amps. |
| Temperatura | 25° | Celcius |
| Max.System Volt. | 1000 Volts | |
| Max.Fuse Rating | 15 Amp. | |
| Cell Technology | Multi-Si Cells | |

ISOZERT



Hanwha SolarOne
GLOBAL ENERGY PRODUCTS & TECHNOLOGY

**HSL60P6-PB-4-250Q**

| | | |
|---|---|---|
| Maximum Power | ( Pmax ) | 250 W |
| Open Circuit Voltage | ( Voc ) | 37.7 V |
| Short Circuit Current | ( Isc ) | 8.82 A |
| Maximum Power Voltage | ( Vmp ) | 29.8 V |
| Maximum Power Current | ( Imp ) | 8.39 A |

All technical data at Standard Test Conditions(STC)
Irradiance Level 1000W/m², Spectrum AM1.5, and Cell Temperature 25 °C

| | |
|---|---|
| Maximum System Voltage | 1000V |
| Nominal Operating Cell Temperature (NOCT) | 45±3°C |
| Temperature Cycling Range | −40°C to +85°C |
| Weight | 19±0.5kg |
| Dimensions | 1636x988x40mm |
| Cell Technology | POLY-Si |
| Maximum Series Fuse Rating | 15A |
| Class C Fire Rating | |

For field connections, use minimum No.12 AWG copper wires insulated for a minimum of 90°C

C US

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www.hanwha-solarone.com

Warning-electrical hazard

4244

# Solar Power

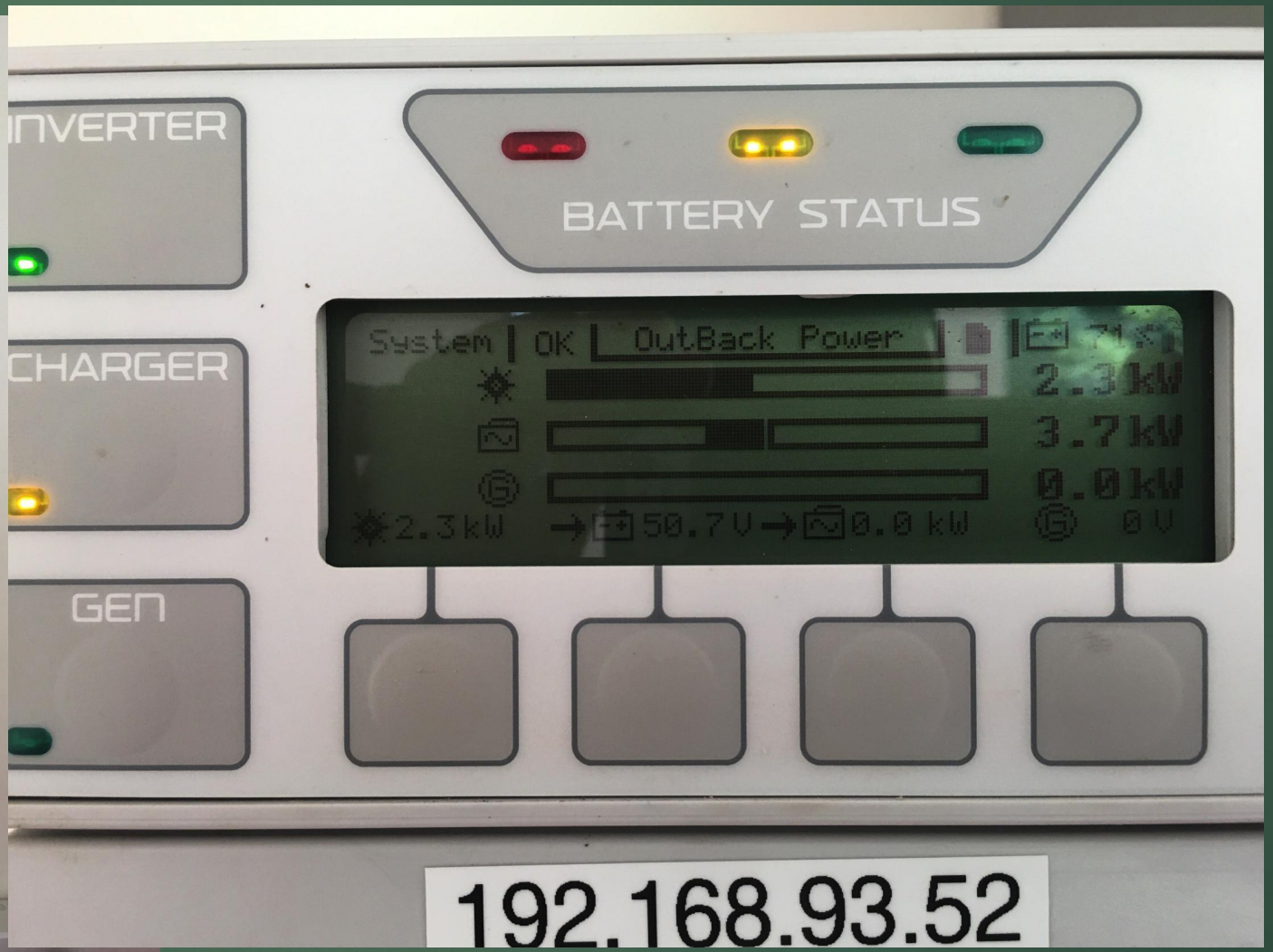
## Why are they installed in groups, on poles?

# Inverter

- Inverter and a Charger
- Takes battery voltage and inverts it into the common electrical voltage used in normal homes and businesses – 120v and 240v split-phase
- Is limited in total power production to 10,000 watts, 8,000 watts continuously.  Can be stacked in parallel to increase capacity
- Battery Protection -  When batteries are low, cuts out power
- When Generator is turned on, sends generator power to Lodge loads and uses leftover power to charge batteries
- Without the inverter, we would be in deep trouble!

# Inverter

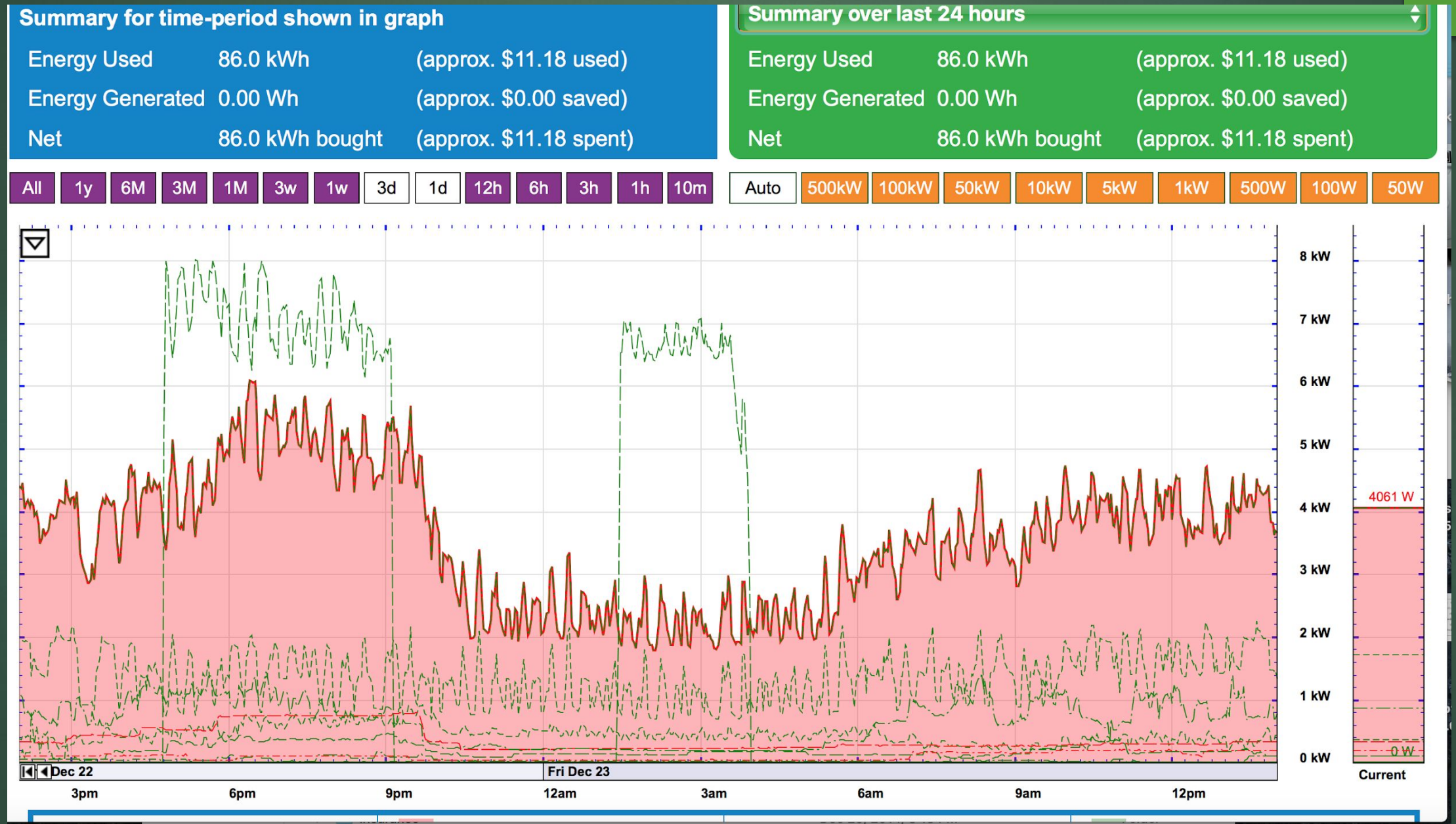

192.168.93.52
FLEXmax
FLEXmax
OutBack Power Systems
OutBack Power Systems
POWER
RADIAN SERIES


INVERTER
CHARGER
GEN
BATTERY STATUS
System | OK | OutBack Power
2.3kW
3.7kW
0.0kW
2.3kW
50.7V
0.0 kW
0 V
192.168.93.52

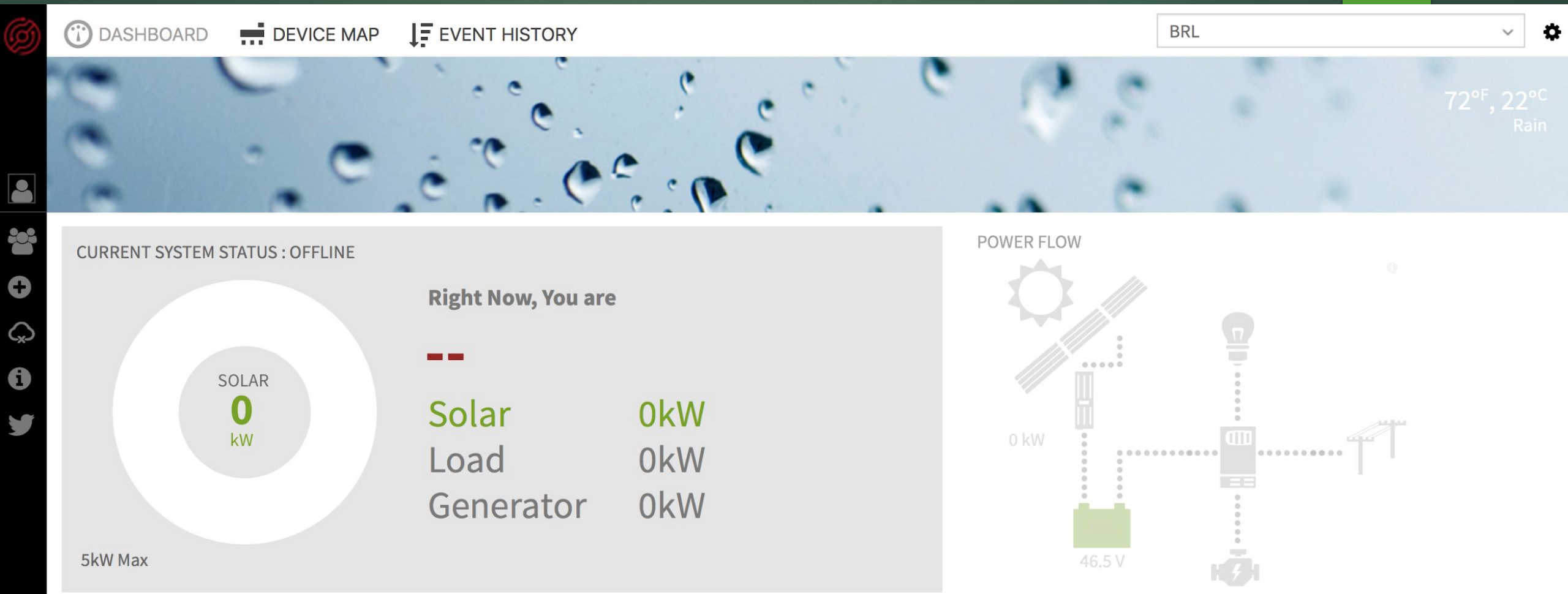
# Monitoring Systems

- Egauge
  - Can view from anywhere with internet connection
  - Monitors every circuit from main panel - LIVE
  - Gives summary of data consumed by circuit
  - Diagnose and repair a problem without shutting down all power
- Optics Re
  - Gives Live access to all the data and information from Inverter
    - Production
    - Load
    - Allows change to Inverter settings from afar

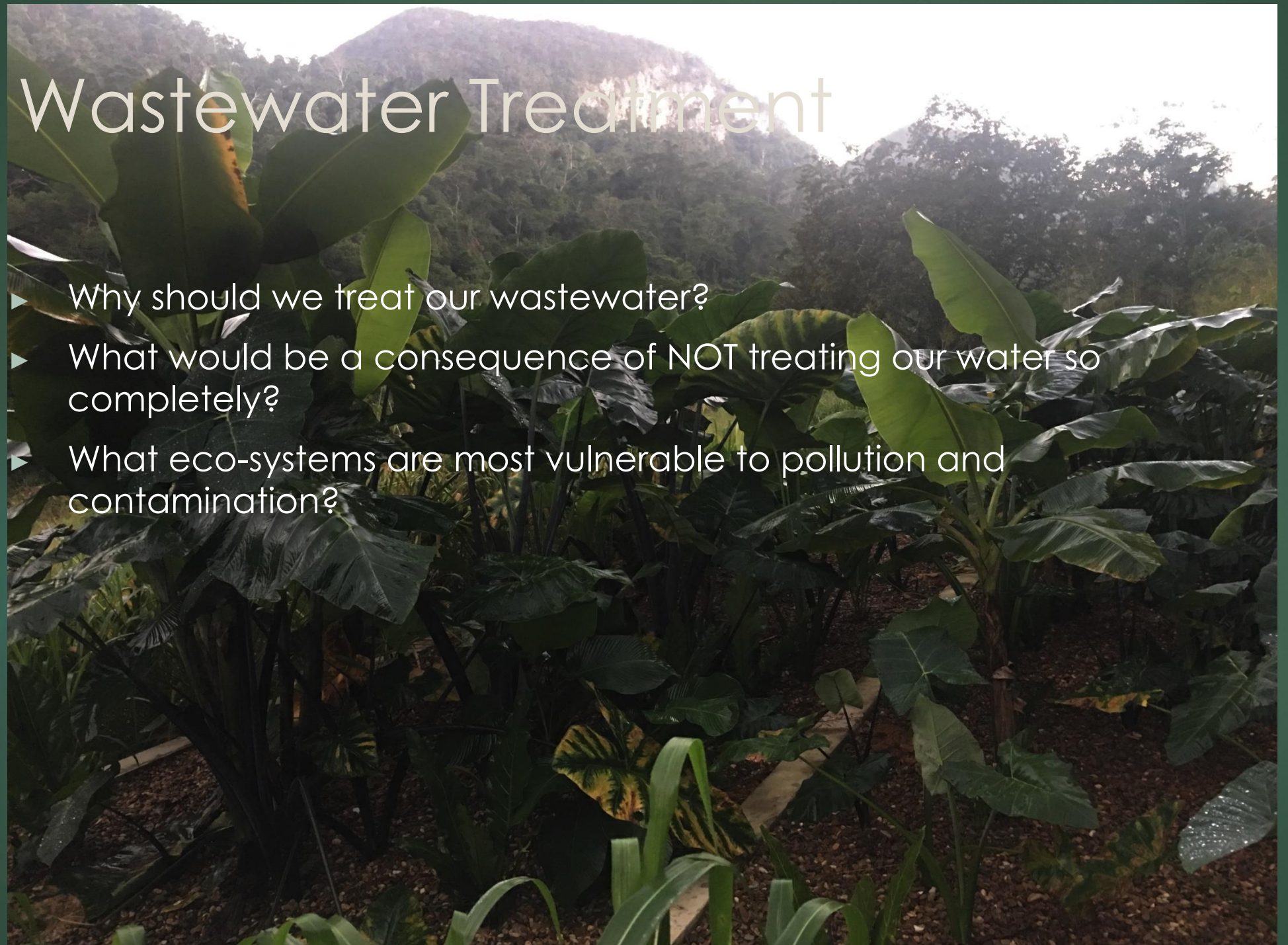
# Monitoring Systems



# Monitoring Systems



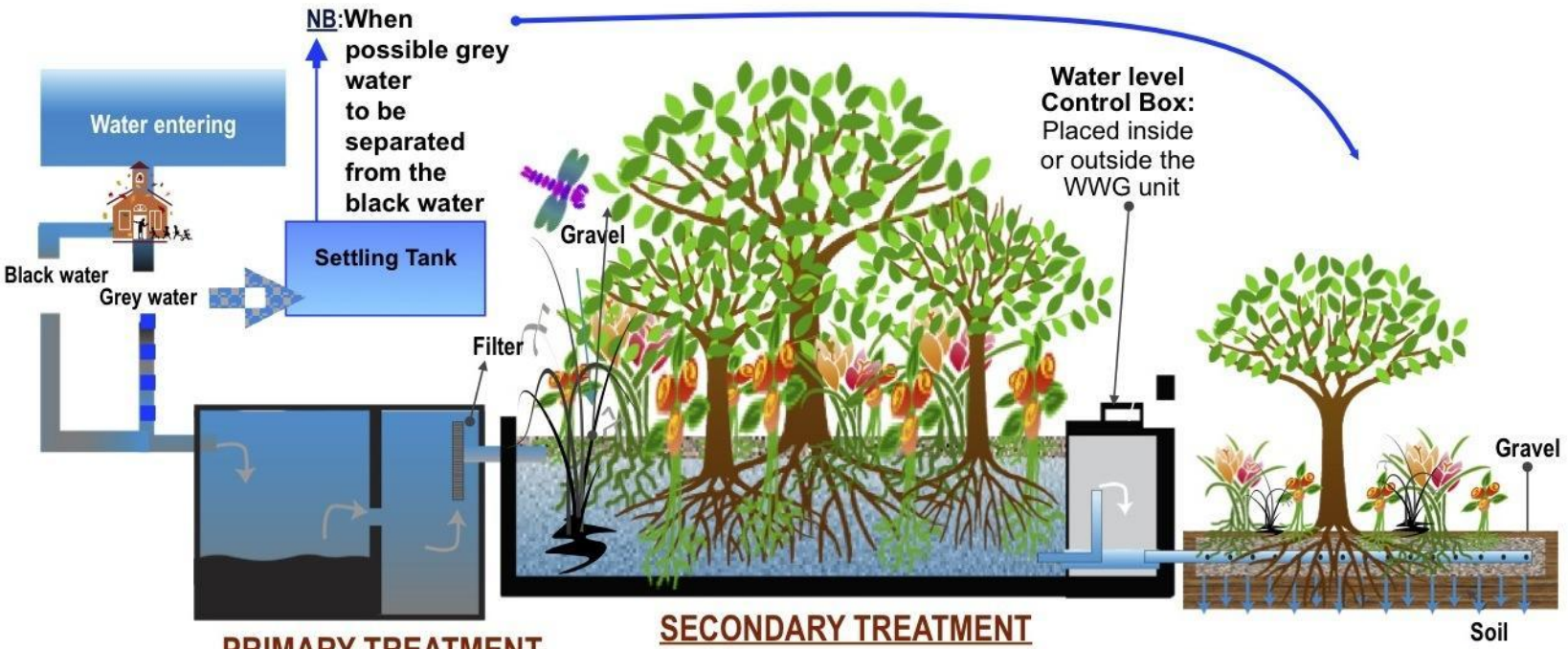
# Wastewater Treatment



- Why should we treat our wastewater?
- What would be a consequence of NOT treating our water so completely?
- What eco-systems are most vulnerable to pollution and contamination?

- Septic
- Wetland
- Aerating Pond

# Schematic for the Wastewater Gardens (WWG) system




## PRIMARY TREATMENT

SEPARATION OF SOLIDS FROM LIQUIDS

*For organic wastewater: Septic tanks (here on schematic), Faecal bags, Imhoff, screener,....*

*For highly polluted wastewater and/or industrial wastewater: system adapted to nature of wastewater*

*-If using a septic tank: Residence time should be at least 2.5 days.*

SLUDGE SECONDARY TREATMENT AND REUSE

If organic: composting, drying-bed, vermicompost, methane production, ...

## SECONDARY TREATMENT

**WWG Unit**

**Subsurface Flow constructed wetland (SFCW)**

*NB: - Drawing here is of an horizontal flow CW with a minimum residence time of 4 days*

*- SFCWs can also be designed to provide PRIMARY treatment or TERCIARY treatment.*

## REUSE OR DISPOSAL OF TREATED WATER

*- Small scale systems: drainage trenches filled with gravel adapted to local soil permeability.*

*- Medium to large scale systems: Terciary treatment applied or direct disposal in water ways or reuse for additional* productive green zone.