Group 4 - Workshop ATC320 - from 10.30 to 12.30

ACTIVITY 1

Problem: Fresh water shortage in the Yuendumu Community
Solution: Solar water purification/ filtration system
Design ideas:

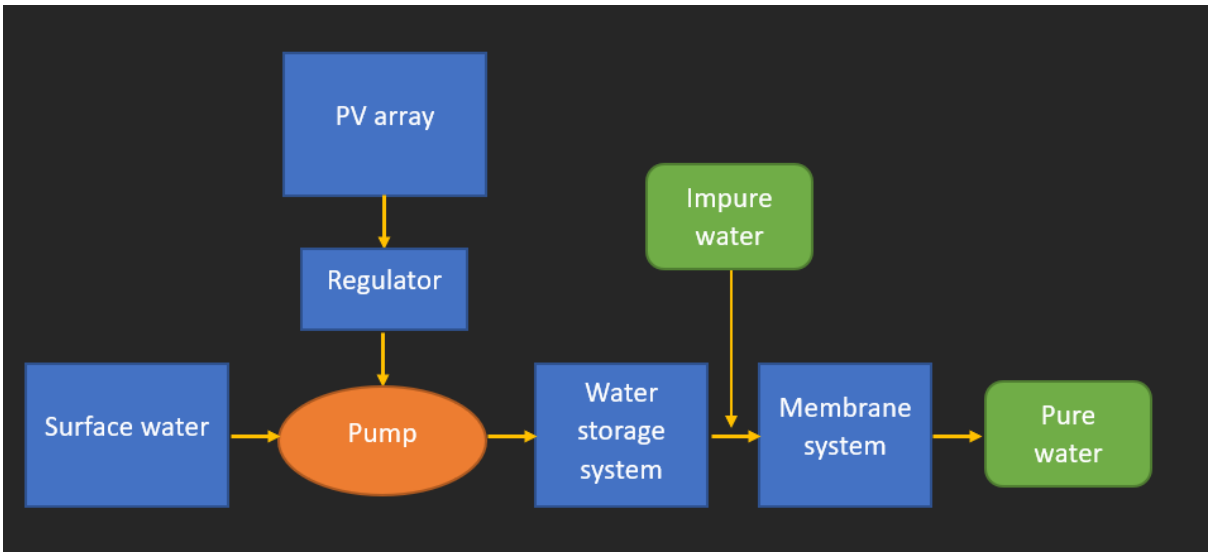
1. **Photovoltaic (PV) panels**: The system can be powered by PV panels that convert sunlight into electricity, which is used to run the water filtration components. The PV panels can be mounted on a roof or on a ground-based rack, and the system can be designed to include a battery bank for energy storage to ensure continuous operation even when the sun is not shining.

- *Combination of technologies/devices & their properties/function:*
  + Main Photovoltaic (PV) panels: These are the main components that convert sunlight into electricity. The PV panels can be mounted on a roof or on a ground-based rack, and the size and number of panels will depend on the power requirements of the water filtration components.
  + Charge controller: A charge controller is needed to regulate the amount of current and voltage going to the battery bank. This helps to prevent overcharging and damage to the battery. The charge controller can also monitor the battery state of charge and automatically disconnect the system if the battery voltage gets too low.
  + Battery bank: A battery bank is needed to store the electricity generated by the PV panels. This helps to ensure continuous operation of the water filtration components even when the sun is not shining. The size of the battery bank will depend on the power requirements of the system and the amount of energy storage needed.
  + Inverter: An inverter is needed to convert the DC (direct current) electricity generated by the PV panels and stored in the battery bank into AC (alternating current) electricity that can be used to power the water filtration components. The size of the inverter will depend on the power requirements of the system.
  + Wiring and connectors: High-quality wiring and connectors are needed to connect the PV panels, charge controller, battery bank, inverter, and water filtration components together. The wiring should be sized appropriately to handle the current and

voltage of the system and should be installed according to local electrical codes and standards.

+ Mounting hardware: Mounting hardware is needed to securely mount the PV panels, charge controller, battery bank, inverter, and water filtration components. The hardware should be designed to withstand the environmental conditions and should be installed according to local building codes and standards.

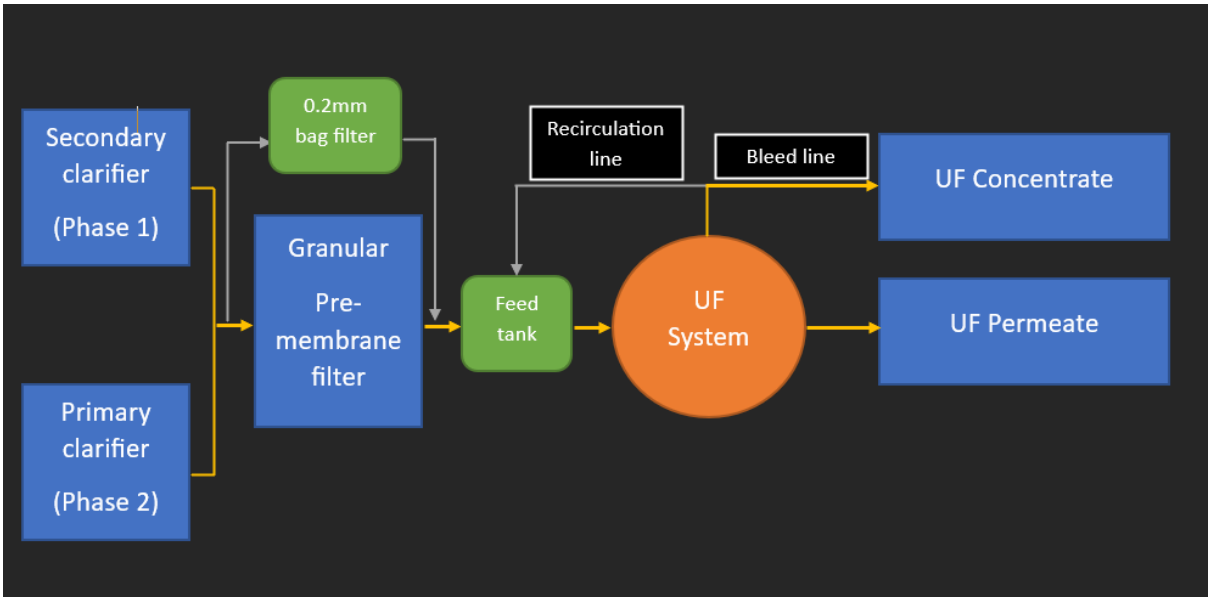
- *Digital literacy:* End-users of PV panels will need some level of digital literacy to install, operate, and maintain the system. This may include understanding how to connect and disconnect the system from the grid, how to monitor the system's performance, and how to troubleshoot any issues that arise.
- *Basic idea demonstration:*



2. **Ultrafiltration (UF) or reverse osmosis (RO) membrane**: The filtration component can be a UF or RO membrane that removes bacteria, viruses, and other impurities from the water. The membrane can be integrated into a small unit that is powered by the PV panels and can be easily transported and installed in remote areas.

- *Combination of technologies/devices & their properties/function:*
  + UF or RO membrane: These are the main components that physically remove bacteria, viruses, and other impurities from the water. UF membranes have a pore size of 0.01-0.1 microns, while RO membranes have a pore size of 0.0001 microns or less. The size and number of membranes will depend on the water flow rate and the desired level of purification.
  + Feed pump: A feed pump is needed to pump the water through the UF or RO membranes. The pump should be sized appropriately to provide the required water flow rate and pressure.

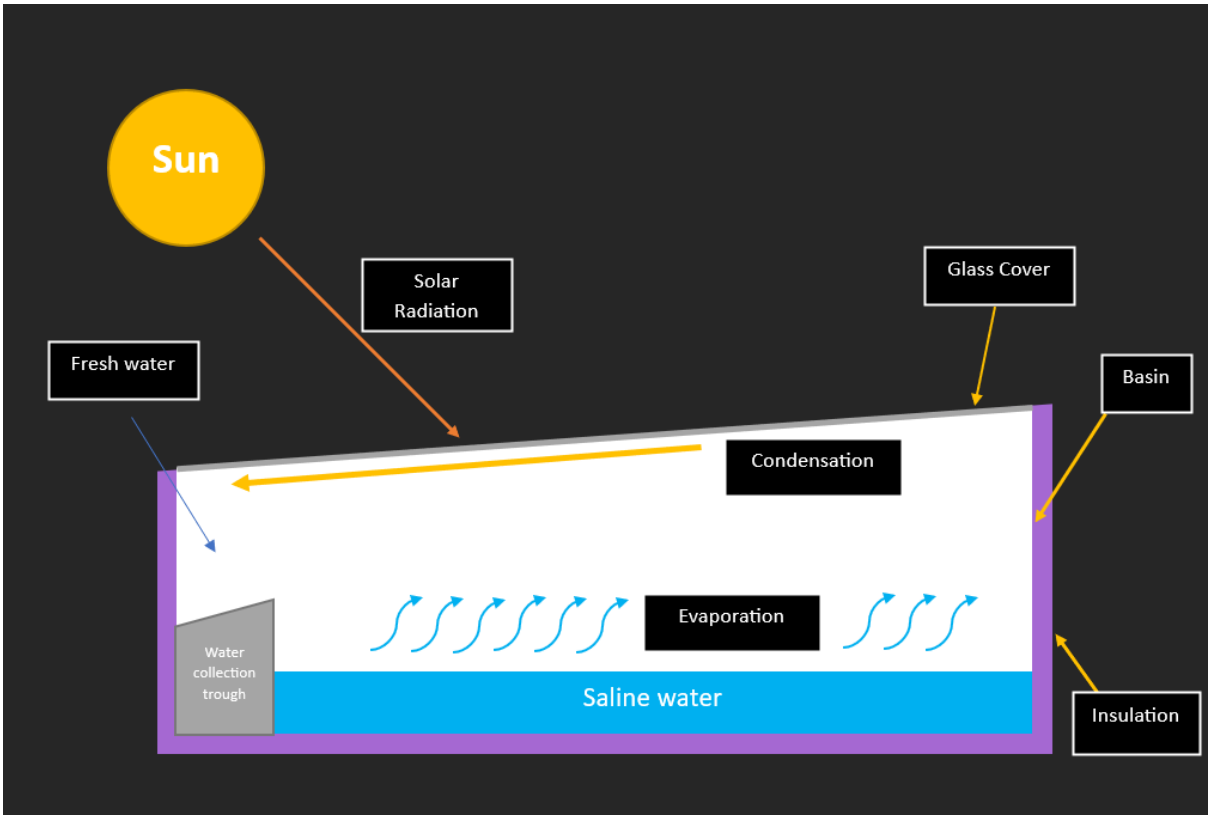
    + Pressure vessel: A pressure vessel is needed to house the UF or RO membranes and maintain the required pressure for filtration. The pressure vessel should be designed to withstand the operating pressure and should be made from materials that are compatible with the water being filtered.
    + Backwash system: A backwash system is needed to periodically clean the UF or RO membranes and remove any accumulated impurities. The backwash system can include a backwash pump, a backwash tank, and a cleaning solution.
    + Pre-filtration: A pre-filtration system is needed to remove larger particles and debris from the water before it enters the UF or RO membranes. The pre-filtration system can include a sediment filter, activated carbon filter, or other types of filters depending on the water quality.
    + Control panel: A control panel is needed to monitor and control the UF or RO system. The control panel can include sensors to measure water pressure, temperature, and flow rate, as well as a controller to adjust the feed pump and backwash system as needed.
    + Storage tank: A storage tank is needed to store the purified water before it is distributed for use. The size of the storage tank will depend on the water demand and the available space.
    + (Water) Distribution system: A distribution system is needed to distribute the purified water to the point of use. The distribution system can include pipes, valves, and faucets, and should be designed to prevent contamination of the purified water.
- *Digital literacy:* End-users of UF or RO membrane systems may not require digital literacy to operate the system, but they may need to be trained on how to clean and maintain the system. Some systems may have digital monitoring and control features, in which case end-users will need to be trained on how to use these features.
- *Basic idea demonstration:*



3. **Passive solar still**: Another option is a passive solar still, which uses the heat of the sun to evaporate water and collect the purified vapor. This design can be simple and low-cost, but may not be as effective as a membrane-based system for removing all impurities.

- *Combination of technologies/devices & their properties/function:*
  + Solar still: The solar still is the main component that converts contaminated water into potable water using the heat from the sun. The solar still typically consists of a shallow basin or tray to hold the contaminated water, and a clear cover to allow sunlight to enter and heat the water.
  + Absorber plate: The absorber plate is an optional component that can be added to the solar still to improve its efficiency. The absorber plate is usually made of metal or other materials that can absorb sunlight and convert it into heat, which is then transferred to the water in the still.
  + Condenser: The condenser is a component that is used to collect the distilled water that is produced by the solar still. The condenser can be a simple collection tray that is placed below the clear cover, or a more complex system that uses a separate cooling surface to condense the distilled water.
  + Insulation: Insulation is needed to minimize heat loss from the solar still and improve its efficiency. Insulation can be added to the sides and bottom of the solar still to reduce heat loss to the surrounding environment.
  + (Water) Distribution system: A water distribution system is needed to distribute the purified water from the solar still to the point of use. The distribution system can include pipes, valves, and faucets, and should be designed to prevent contamination of the purified water.

- *Digital literacy:* End-users of a passive solar still may not require digital literacy to operate the system, as it is a simple and self-contained device that requires no external power or monitoring.
- *Basic idea demonstration:*



4. **Solar still backpack**: A much cheaper, lighter and more convenient version of a common solar water filtration system, which may be a backpack with a built-in solar still that uses the heat of the sun to evaporate water and collect the purified vapor. This can be useful for hikers and campers who need a lightweight and portable water purification system.

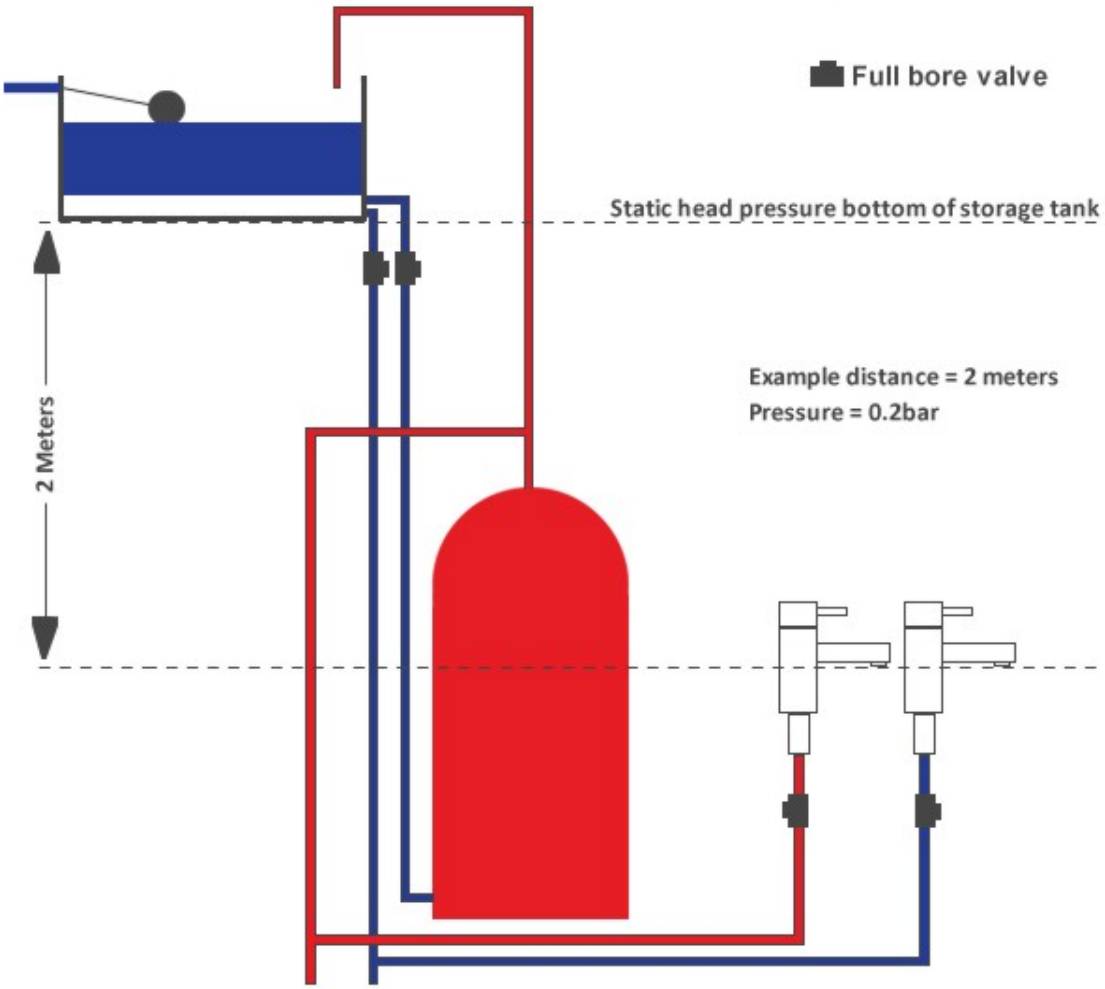
- *Combination of technologies/devices & their properties/function:*
  + <u>Tiny solar still:</u> The solar still is the main component that converts contaminated water into potable water using the heat from the sun. For a portable solar still backpack, the solar still is usually compact and lightweight. One example is a small basin or tray made of durable materials that can withstand the rigors of travel, and a clear cover to allow sunlight to enter and heat the water.
  + <u>Reflective material:</u> Reflective material can be added to the sides and bottom of the solar still to improve its efficiency. The reflective material can be made of Mylar or other reflective films that reflect sunlight onto the water in the still, increasing its temperature and accelerating the evaporation process.

    + Insulation: Insulation is needed to minimize heat loss from the solar still and improve its efficiency. For a portable solar still backpack, insulation can be added to the sides and bottom of the basin or tray to reduce heat loss to the surrounding environment.
    + Condenser: The condenser is a component that is used to collect the distilled water that is produced by the solar still. For a portable solar still backpack, the condenser can be a small container or tube that is connected to the basin or tray, and is designed to collect the distilled water that evaporates and condenses on the clear cover.
    + Water drinking container: A drinking container is needed to hold the purified water before it is consumed. For a portable solar still backpack, the drinking container can be a small, lightweight container that is designed to fit inside the backpack and hold a sufficient amount of purified water
    + Smart backpack frame and harness: The backpack frame and harness are needed to support the weight of the solar still, reflective material, insulation, and drinking container, and to distribute the weight evenly across the shoulders and hips. The backpack frame and harness should be adjustable to fit different body sizes and shapes, and should be made of lightweight, durable materials.
- *Digital literacy:* End-users of a portable solar still backpack will not require digital literacy to operate the device, but they may need to be trained on how to assemble and disassemble the components, how to use the reflective material and insulation to improve efficiency, and how to collect and store the purified water.
- *Basic idea demonstration:* (This one also includes almost the same components and structure as the mentioned Passive solar still, but on a much smaller scale - a backpack)

5. **Gravity-fed system using solar energy**: The system can be designed to be gravity-fed, which means that water is pumped up, mostly using solar energy, to a high point and then flows down through the filtration components. This design can reduce the energy needed for pumping and can be useful in areas with low water pressure.

- *Combination of technologies/devices & their properties/function:*
    + Water storage tank: The water storage tank is a container that stores the water that is pumped from the source to the distribution point. The water storage tank should be sized appropriately to meet the water demand and storage requirements of the gravity-fed water system.

    + DC pump: The DC pump is a type of water pump that is powered by electricity from the solar panel and battery. The DC pump should be sized appropriately to meet the water demand and lift requirements of the gravity-fed water system.
    + Water distribution system: The water distribution system is a network of pipes and valves that distribute the water from the storage tank to the point of use. The water distribution system should be designed to prevent contamination of the water and to meet the water demand of the system.
    + Mounting structure: The mounting structure is a framework that supports the solar panel and battery. The mounting structure should be sturdy and designed to withstand wind and weather conditions.
    + Solar panel & solar charge controller: The solar panel is the main component that converts solar energy into electrical energy. The solar panel should be sized appropriately to provide enough electrical power to run the pump and other components. The solar charge controller is a device that regulates the amount of electrical power that is sent from the solar panel to the battery. The solar charge controller prevents overcharging of the battery and extends its life.
    + Battery: The battery stores the electrical energy generated by the solar panel during the day for use at night or during periods of low sunlight. The battery should be sized appropriately to provide enough power for the pump and other components, and should be a deep-cycle battery designed for continuous use.
- *Digital literacy:* End-users of a gravity-fed water system using solar energy may not require digital literacy to operate the system, as it is a simple and self-contained device that requires no external power or monitoring. However, they may need to be trained on how to install and maintain the system, how to troubleshoot any issues that arise, and how to use the water distribution system.
- *Basic idea demonstration:*


Full bore valve
Static head pressure bottom of storage tank
2 Meters
Example distance = 2 meters
Pressure = 0.2bar