1st Activity

Aim : Develop design idea for your team township challenge

Instructions :

1. Develop your team design ideas based on the identified problem.
2. Each design idea should list combination of technologies and devices for a solution.
3. Use different approaches in different stage of your design idea.
4. List each device properties and how it functions.
5. Use a smart tool (use shapes, draw in MS word or Power point) to create, visualise and design your team design ideas.
6. Does the technology/device need any digital literacy for an end user?

Teamwork:
45 minutes

Angel Lim Sze Ying – 105562518 (J24041959)

1. **Develop your team design ideas based on the identified problem.**

   Design idea: Renewable Energy-based Battery Energy Storage System

   - **Description**: In remote areas such as Yuendumu, people have been dealing with energy insecurity, which severely affects their daily routines that rely on the use of electricity.
   - **Benefits**: Provide the community with reliable and sufficient access to electrical energy using an energy storage system.

2. **Each design idea should list a combination of technologies and devices for a solution.**

   Technologies involved in *Renewable Energy-based Battery Energy Storage System*:

   - Renewable Energy Sources: Solar panels and wind turbines
   - Battery Storage System: Lithium-ion batteries
   - Battery Management System
   - Power Conversion System: Inverter and Converter
   - Charge Controller
   - Energy Management System: EMS software and smart meters
   - Cooling and Ventilation System: Fans and Heat Sinks
   - Wiring and cabling

3. **Use different approaches in different stages of your design idea.**

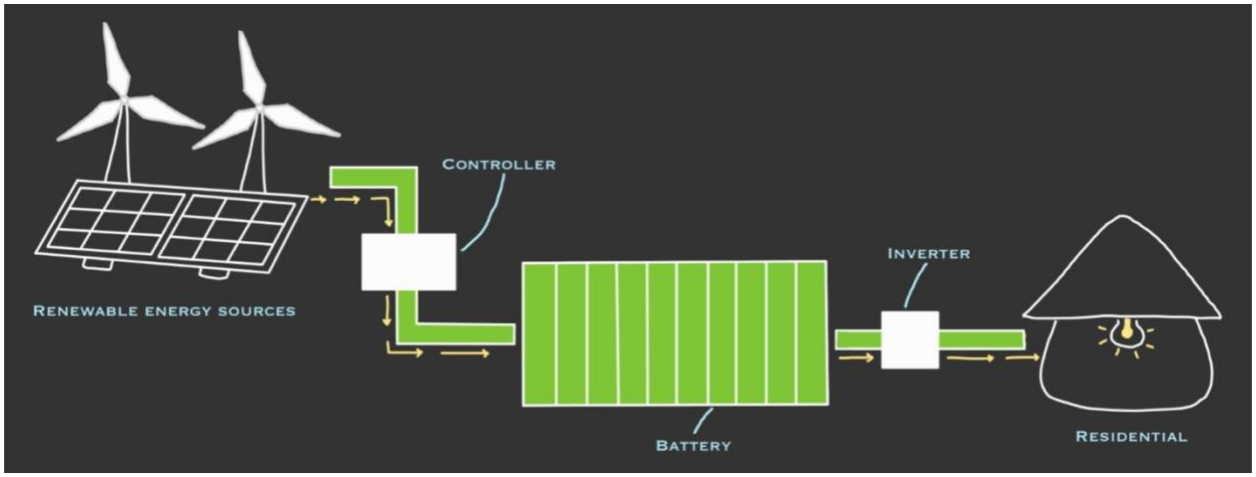
   Reduce, Prevent and Analyse: The system integrates renewable energy technologies, such as solar panels and wind turbines, to **reduce** reliance on non-renewable energy, offering a more sustainable and eco-friendly solution. Apart from that, the system requires a Battery Management System (BMS), which helps to **prevent** issues such as overcharging, overheating and deep discharging by monitoring and controlling the charge and discharge cycles. Finally, the system also integrates an Energy Management System (EMS) which function to coordinate the flow of energy by analyzing the energy consumption and battery status.

4. List each devices' properties and how it functions.

- **Renewable Energy Sources**
  - Solar Panels: Convert sunlight into electrical energy.
  - Wind Turbines: Convert wind energy into electrical energy.
- **Battery Storage System**
  - To store energy using lithium-ion batteries.
  - Lithium-ion batteries: High efficiency in handling large-scale energy storage, lithium-ion batteries offer high energy density, allowing more energy to be stored in a smaller unit. Additionally, they are easily scalable and can be charged and discharged quickly compared to the other battery types.
- **Battery Management System**
  - Monitors and regulate batteries charge and discharge cycles.
  - Prevents overcharging, overheating and deep discharging of batteries.
  - Ensures overall safety of system operations.
- **Power Conversion System**
  - Inverter: Converts Direct Current (DC) to Alternating Current (AC) for appliance use.
  - Converter: Converts Alternating Current (AC) to Direct Current (DC) to charge the batteries when needed.
- **Charge Controller**
  - Regulates energy flow between renewable sources and batteries.
  - Ensures batteries are charged efficiently without overcharging.
  - Protects battery from damage and optimizes its lifespan.
- **Energy management system (EMS)**
  - Monitors and controls the flow for energy generation, storage and distribution.
  - Smart Meters: Provide real-time data to measure energy usage and storage levels.
- **Cabling and Wiring Connections**
  - Ensure proper connections between all components within the system, including solar panels, wind turbines, inverters and converters, batteries and other components.
- **Cooling and Ventilation System**
  - Fans and Heat Sinks: Dissipate heat from the electrical components to prevent devices from overheating.

5. **Use a smart tool to create, visualize and design your team design ideas.**

Illustration of Renewable Energy-based Battery Storage System:



6. **Does the technology/device need any digital literacy for an end user?**

The Renewable Energy-based Battery Energy Storage System (BESS) can operate automatically once the installation is completed. Residents in remote areas do not need any technical knowledge, only to ensure proper cabling connections to the storage system, which allows the conversion of energy from renewable sources into electrical energy for residential daily use. The converted energy, along with any excess energy, will be stored in the system and discharged to the residential area as needed. However, annual maintenance is required, and batteries must be replaced, when necessary, by the professionals to ensure safety and optimal system performance.

Solar Power and batteries system – Yadanar Theint

1. **Develop your team design ideas based on the identified problem.**

   Solar Power for Community

   Description – In Yuenmudu, the community does not get stable and reliable electricity from the government. Most of the time, they rely on fuel which is expensive for them.

   Benefits – They can save money on fuel and reduce carbon emissions and footprint.

2. **Each design idea should list a combination of technologies and devices for a solution.**

   Technology involved in the Solar renewable energy is

   - Sunlight will directly fall down on to the cells in solar panels
   - Solar cells will store it as Direct current.
   - Solar panel will relate to cables to the inverter inside the home.
   - An inverter will convert the DC current as AC which is connected to the battery to store to use whenever needed.
   - Then the electricity is ready to use from the battery.

3. **Use different approaches in different stages of your design idea.**

   Design 2 approach (Reduce, Prevent and Predict) - Solar renewable energy **reduces** the problem of unstable electricity among the community and cost for fuel to use using the shortage of electricity. This also **prevents** the community from wasting food in fridge or other problems like health and education because of electricity outage. Since the requirement for solar panels and cost for it can be **predicted** upon the usage duration and need amount, they can reduce and do not need to worry about the extra cost by installing this method at their houses.

4. **List each device's properties and how it functions.**

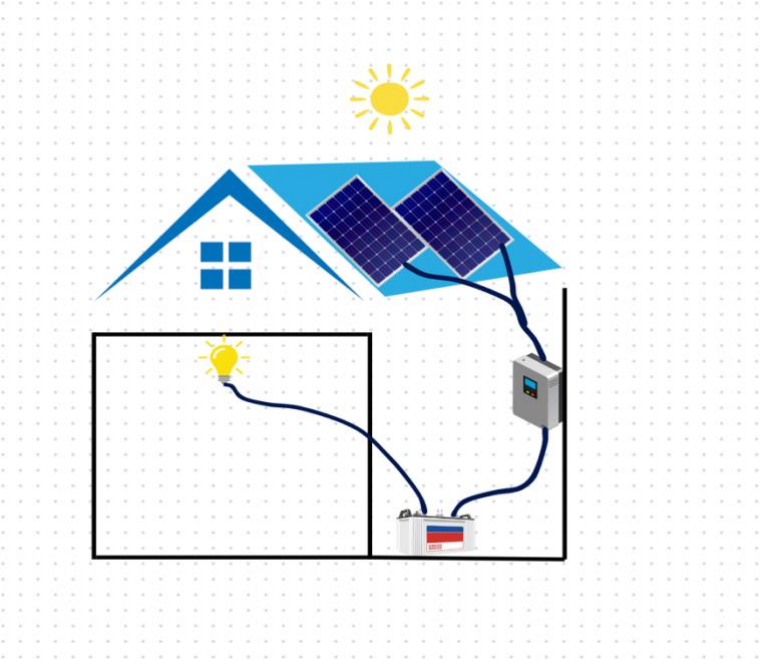
   Lists of devices – Photovoltaics (PV) solar panels, invertor and battery.

   Solar Panels - photovoltaics (PV)

   There are two main types of solar energy technologies—photovoltaics (PV) and concentrating solar-thermal power (CSP).

- Photovoltaic (PV) materials and devices harness sunlight to generate electrical energy. An individual PV device is known as a cell, typically producing around 1 to 2 watts of power and made from various semiconductor materials. These cells are quite thin, often less than the thickness of four human hairs, and are encased in protective layers of glass and/or plastic to endure outdoor conditions.
- Inverters - Inverters are used to convert the direct current (DC) electricity generated by solar photovoltaic modules into alternating current (AC) electricity, which is used for local transmission of electricity, as well as most appliances in our homes.
- Battery - Batteries allow for the storage of solar photovoltaic energy, so we can use it to power our homes at night or when weather elements keep sunlight from reaching PV panels.

5. **Use a smart tool (use shapes, draw in MS word or Power point) to create, visualize and design your team design ideas.**



6. **Does the technology/device need any digital literacy for an end user?**

   Yes, using solar power technology requires some basic digital skills from users. They need to know how to operate solar panels, check energy output, and fix simple issues.

To help with this, organizers should provide short training sessions on how the system works, how to install it, safety tips, and how to monitor it. This will help users make the most of their solar energy systems and keep them working well.

Biomass Energy with Food and general waste – Yadanar Theint

1. **Develop your team design ideas based on the identified problem.**

   Description – Biomass from food and general waste is a valuable resource found in every household. By collecting and transforming these materials, we can create sustainable energy, reduce landfill waste, and minimize greenhouse gas emissions. This process promotes a circular economy and contributes to a greener future by harnessing the potential of what we usually discard.

   Benefits – Biomass from food and general waste has many benefits. It helps cut down on waste by keeping organic materials out of landfills, which helps the environment. By creating renewable energy, it reduces our dependence on fossil fuels and lowers harmful emissions. This process also makes nutrient-rich compost, which is good for farming. It supports a circular economy by promoting recycling and efficient use of resources while creating jobs in waste management and energy. Overall, it encourages community involvement in sustainability efforts.

2. **Each design idea should list a combination of technologies and devices for a solution.**

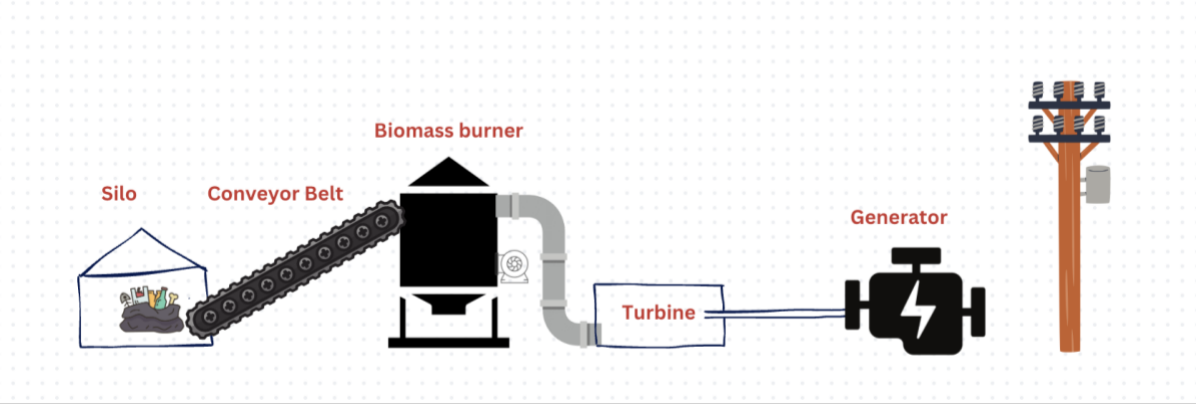
   - Waste (general, wood and agricultural) is collected and stored at silo.
   - There will be a conveyor belt to convey waste from silo to the biomass burner. (Pyrolysis)
   - The waste is burnt at the burner at a moderate temperature to produce liquid vapor and char or ash.
   - The char will be settled down at burner and the vapor will go the turbine from the chamber.

- The steam will run the turbine, and it will run the generator to produce electricity.

3. **Use different approaches in different stages of your design idea.**

   Design 2 Approach (Analyse, Eradicate and Prevent) - To successfully implement biomass energy solution, we first need to **analyze** the average electricity usage in the community to determine the necessary biomass production. This will **eradicate** household waste and lower the carbon footprint from liquid fuels used in generators. Switching to biomass can also **prevent** health issues related to waste buildup and address problems caused by power outages, leading to a more sustainable and dependable energy source for the community.

4. **List each device properties and how it functions.**
   - Silo – A garage to store waste.
   - Conveyor belt – to convey waste from silo to biomass burner.
   - Biomass burner – Burn the waste to produce vapor containing steam, heat and ash.
   - Turbine – the steam will generate the turbine.
   - Generator – It will be connected to the turbine. As the turbine is running, the generator will generate electricity.
5. **Use a smart tool (use shapes, draw in MS word or Power point) to create, visualize and design your team design ideas.**



6. **Does the technology/device need any digital literacy for an end user?**

   Yes, using biomass energy technology requires some basic digital skills. Users should know how to operate systems for collecting and processing organic waste, monitor energy output, and potentially use apps for managing energy and waste. Having basic troubleshooting skills can help them fix common problems. Offering training and resources can make users more comfortable with these technologies.

Shin Thant Thi Ri – 104842811 (J22037681)

Solar Concentrated Thermal Power System with Thermal Storage

1. **Develop your team design ideas based on the identified problem.**

   Solar Concentrated Thermal Power System with Thermal Storage

   - **Description**: A solar concentrated thermal power system with integrated thermal storage, designed to provide stable electricity to Yuendumu using the abundant desert sunlight.
   - **Benefits**: Delivers consistent power output even after sunset, reduces reliance on expensive fuel, and utilizes local resources effectively.

2. **Each design idea should list a combination of technologies and devices for a solution.**

   Technologies involved in Solar Concentrated Thermal Power System with Thermal Storage:

   - Heliostats (Sun-tracking Mirrors)
   - Central Solar Power Tower
   - Molten Salt Heat Transfer and Storage System
   - Steam Turbine and Generator
   - Air-cooled Condenser
   - Power Distribution Equipment
   - Control and Monitoring System
   - Weather Station

3. Use different approaches in different stages of your design idea.

Design 2

- **Reduce**: Minimizes reliance on fossil fuels for electricity generation by harnessing abundant solar energy, reducing the community's carbon footprint and fuel costs.
- **Prevent**: Implements a robust thermal storage system to prevent power outages during nighttime or cloudy periods, ensuring a stable and reliable electricity supply.
- **Predict**: Utilizes weather forecasting and advanced monitoring systems to predict energy production and optimize system performance, allowing for proactive management of power resources.

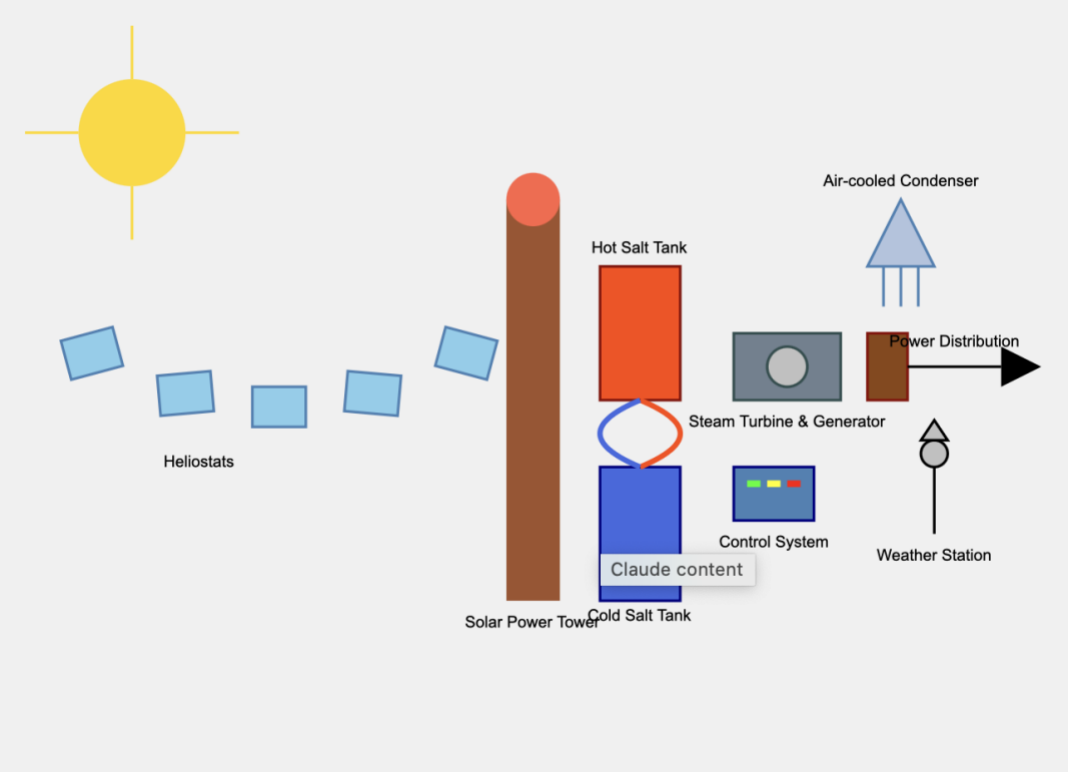
4. List each device's properties and how it functions.

Device Properties and Functions:

- Heliostats (Sun-tracking Mirrors):
  - Large, flat mirrors that track the sun's movement
  - Reflect and concentrate sunlight onto the central receiver
  - Computer-controlled for precise positioning
- Central Solar Power Tower:
  - Tall structure with a receiver at the top
  - Absorbs concentrated sunlight, heating the molten salt
  - Designed to withstand high temperatures
- Molten Salt Heat Transfer and Storage System:
  - Circulates molten salt to absorb and store heat
  - Maintains heat for hours after sunset
  - Consists of hot and cold storage tanks
- Steam Turbine and Generator:
  - Converts thermal energy to mechanical energy, then to electricity
  - Designed for high efficiency and reliability

- Air-cooled Condenser:
    - Condenses steam back to water in the power cycle
    - Uses minimal water, suitable for desert environments
- Power Distribution Equipment:
    - Transformers and switchgear to deliver electricity to the community
    - Includes safety mechanisms and power quality control
- Control and Monitoring System:
    - Manages heliostat positioning, energy flow, and power generation
    - Provides real-time data on system performance
    - Enables remote monitoring and operation
- Weather Station:
    - Monitors local weather conditions
    - Helps predict energy production and optimize system performance

5. **Use a smart tool (use shapes, draw in MS word or Power point) to create, visualize and design your team design ideas.**



The diagram shows how sunlight is concentrated by the heliostats onto the solar tower, which heats the molten salt. This heat is then used to generate steam, drive a turbine, and produce electricity. The system's layout demonstrates how it can provide power even after sunset, thanks to the thermal storage capability.

6. **Does the technology/device need any digital literacy for an end user? Digital Literacy Requirements for End Users:**
   - Minimal digital literacy required for general users:
     - Basic energy consumption information could be provided through simple displays or a user-friendly app
     - Community education programs on energy conservation and system benefits
   - System operation requires trained technicians, not end users
   - Opportunities for local job creation in system maintenance and operation
   - Optional community engagement through guided tours and educational programs about the technology

Joshua Sanjay King – 105282612 (J23039507)

1. **Develop your team design ideas based on the identified problem.**
   - To address the energy needs of Yuendumu, we propose the development of a **nuclear power plant** as a sustainable solution to provide reliable electricity to the community.
2. **Each design idea should list a combination of technologies and devices for a solution.**
   - **Nuclear Reactor**: Generates heat through nuclear fission.
   - **Turbines and Generators**: Convert heat to electricity.
   - **Cooling Systems**: Manage the heat produced in the reactor.
   - **Control Systems**: Ensure the safe operation of the reactor and manage output.
   - **Waste Management Systems**: Safely handle and store radioactive waste

3. **Use different approaches in different stages of your design idea.**

Design 5

Analyze (24/7) the problem in different stages:
Continuous monitoring of nuclear reactors and safety protocols can help in real-time analysis of the plant's operations, ensuring safe and consistent electricity generation.

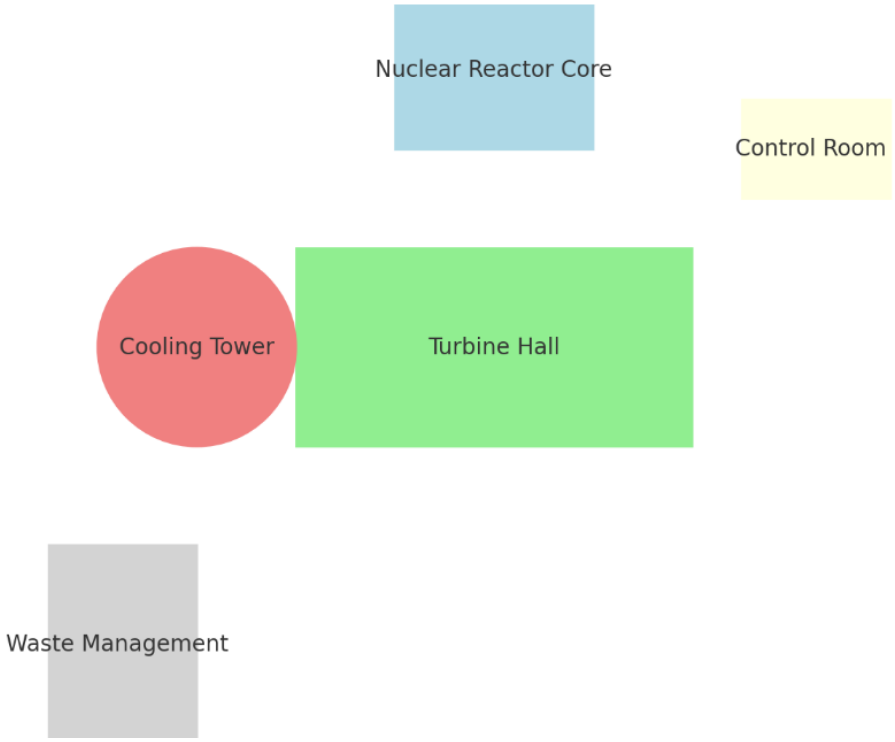
Reduce the problem with minimum or maximum impact in different phases
Employing advanced safety measures and redundant systems can reduce the chances of nuclear accidents, ensuring safer energy production with minimal environmental impact.

Prevent the problem to reduce the impact
Implementation of fail-safes and automatic shutdown systems in the nuclear reactor prevents meltdowns or overheating, reducing potential catastrophic impacts.

Predict the problem before it occurs
Predictive maintenance and AI-driven monitoring systems can predict potential faults or failures in the plant infrastructure, ensuring preventive action is taken before any major problem arises.

4. **List each devices' properties and how it functions.**
   - **Nuclear Reactor**: Converts nuclear energy into thermal energy. It operates by fission of uranium atoms, producing heat.
   - **Turbines**: Use steam generated from heat to spin and generate electricity.
   - **Cooling System**: Maintains optimal operating temperatures for the reactor and prevents overheating.
   - **Control Rods**: Used to absorb neutrons and regulate the fission reaction to maintain safety.
   - **Waste Management Facility**: Safely store spent nuclear fuel and radioactive materials until a long-term disposal solution is implemented.

5. **Use a smart tool to create, visualize and design your team design ideas.**



- **Nuclear Reactor Core**: The center of the operation where fission occurs.
- **Turbine Hall**: Converts heat from the reactor into electricity.
- **Cooling Tower**: Regulates temperature and cools down the systems.
- **Control Room**: Where operations are monitored and controlled.
- **Waste Management Facility**: Safely stores radioactive waste.

6. **Does the technology/device need any digital literacy for an end user?**

- Yes, while the operation of the nuclear power plant will primarily be managed by trained professionals, basic digital literacy may be required for community members to understand safety protocols, emergency procedures, and to participate in discussions regarding energy management and usage.