CARE FOR CREATION

HARNESSING RENEWABLE ENERGY AS A CLIMATE RESPONSE

Manila Episcopal Area
Philippines Central Conference
THE UNITED METHODIST CHURCH

DISASTER RISK REDUCTION PROGRAM MANAGEMENT

Supported by:
UMCOR

CREST

Table of Contents

1

Care for Creation

Re-affirmation of our Stewardship Calling
Biblico Theological Reflection

5

The Path towards Energy Transition

6

Energy Management and Conservation

9

Solar PV Rooftop

This publication is created by the Manila Episcopal Area Disaster Management Office (MEA DMO) supported by United Methodist Committee on Relief (UMCOR), and Center for Renewable Energy and Sustainable Technology (CREST).

Copyright 2021

This publication is protected under the Creative Commons License BY-NC. It may be produced freely in part of in whole for non commercial use as long as the reproduced work is properly attributed to the copyright holders.

CARE FOR CREATION:

Re-affirmation of our Stewardship Calling

Biblico Theological Reflection

Introduction

According to scientific studies and reports, the world's environment is consistently dwindling and in a state of decay. Half of the forests that originally covered 46% of the Earth's land surface are gone. Only one-fifth of the Earth's original forests remain pristine and undisturbed.

Between 10 to 20% of all species will be driven to extinction in the next 20 to 50 years. Based on current trends, an estimated 34,000 plant and 5,200 animal species - including one in eight of the world's bird species - face extinction. Almost a quarter of the world's mammal species will face extinction within 30 years. Up to 47% of the world's plant species are at risk of extinction.

Sixty percent (60%) of the world's coral reefs, which contain up to one-fourth of all marine species, could be lost in the next 20-40 years. Sixty percent of the world's important fish stocks are threatened from overfishing.

Desertification and land degradation threaten nearly one-quarter of the land surface of the globe. Over 250 million people are directly affected by desertification, and one billion people are at risk.

Global warming is expected to increase the Earth's temperature by 3C (5.4F) in the next 100 years, resulting in multiple adverse effects on the environment and human society, including widespread species loss, ecosystem damage, flooding of populated human settlements, and increased natural disasters.

An estimated 40-80 million people have been forcibly evicted and displaced from their lands to make way for the construction of large dams, resulting in economic and social devastation for these people.[i]

The degradation of God's Creation through the depletion of resources, habitat destruction, wildlife extinction and pollution, point to a combination of increasing human population, unsustainable economic growth or affluence, and application of resource-depleting and polluting technology.[ii]

These human activities have warmed the planet in the past 50 years, and climate change impacts are accelerating contributing to severe droughts, floods, typhoons, while spreading diseases like malaria, dengue and water-borne illnesses. It is damaging our critical ecosystems --- coral reefs, rainforests, marine, freshwater ecosystems. The world is on course to see entire island nations disappear.[iii]

These Biblico Theological Reflections were a combination of sifting out documents and presentations on environmental degradation and climate change from available online references, and citing of the previous BTR on Climate Change written by UMC pastors and from the umc.org resources on Care for Creation. The main objective of this study material is to Re-affirm our stewardship for Care for God's Creation.

Biblical Verses on Care for Creation

I. Everything God Created, Good and in Order

Genesis 1:1 *"In the beginning God created the heaven and the earth."*

Genesis 1:24-25 *And God said, "Let the earth bring forth living creatures of every kind: cattle and creeping things and wild animals of the earth of every kind." And it was so, God made the wild animals of the earth of every kind, and the cattle of every kind, and everything that creeps upon the ground of every kind. And God saw that it was good.*

1 Chronicles 29:11 *Yours, O LORD, are the greatness, the power, the glory, the victory, and the majesty; for all that is in the heavens and on the earth is yours; yours is the kingdom, O LORD, and you are exalted as head above all.*

Psalm 24:1-2 *The earth is the LORD's and all that is in it, the world, and those who live in it; for God has founded it on the seas and established it on the rivers.*

Colossians 1:15-16 *Jesus is the image of the invisible God, the firstborn of all creation; for in him all things in heaven and on earth were created, things visible and invisible, whether thrones or dominions or rulers or powers-- all things have been created through him and for him.*

"All creation is the Lord's, and we are responsible for the ways in which we use and abuse it. Water, air, soil, minerals, energy resources, plants, animal life, and space are to be valued and conserved because they are God's creation and not solely because they are useful to human beings. God has granted us stewardship of creation. We should meet these stewardship duties through acts of loving care and respect." [iv]

Gen 1:1 – 2:15: We can see from these passages that God create intentionally and orderly. He creates for the first three days (day/night; sky/water; water/land) and fills what He created for the next 3 days (sun/stars/moon; sea creatures/birds; animals/mankind). With each step, we see the Lord create each "according to their kinds." And with each step, the Lord sees what He made and declares that it is good.

The content of God's creative activity is ordered in terms of a parallel relationship between habitat and inhabitants: days 1 and 4; days 2 and 5; days 3 and 6. Notice how God prepared first the abode of the living beings that He would create next. A system of interdependence among all of God's creations emerges. Then, the 7-day order established a temporal order to be observed by all human beings so that human life will be in tune with the order of creation. [v]

We have this human instinct to feel that we are superior to the animals and nature, the prepositions of this verse in Genesis 1:1. Like all animals are only parts of nature and God's creation, God- is the owner- it is indeed the declaration of Genesis 1:1 that it is God and we are God's Stewards.

We must become aware of our actions and take steps before it becomes too late.

Let us always begin and end our thoughts that it is God! The Creator and Owner of everything.

We shall pass through this world but once; let us take every opportunity to take care of the resources handed to us, we must be aware of the little things that we can do to keep our environment healthy - as like the earth we only have one natural world.

We are part of God's creation from the very beginning. God makes all things beautiful. Let us preserve the beauty of nature. [vi]

II. Care for Creation and not Dominion and Exploitation

Genesis 2:15 *The Lord God took the man and put him in the Garden of Eden to work it and take care of it.*

Genesis 2:18-19 *The Lord God said, "It is not good for the man to be alone. I will make a helper suitable for him." Now the Lord God had formed out of the ground all the wild animals and all the birds in the sky. He brought them to the man to see what he would name them; and whatever the man called each living creature, that was its name.*

God's creative work has to do with more than human beings. Large portions of Genesis 1 testify about the creation of that which is other than humans. Though the first human beings were created in the likeness of God (plural- in our image [vs.26]), this image of God is seen in terms of God's loving relationships with everyone in the created order, and which He passed on to humankind as His responsible steward/partner in the care of the non-human elements of creation. So much so that the words *subdue* and *have dominion* must not be taken to mean exploitation but cultivation, improvement and nurturing of the non-human creation. *Subdue* and *have dominion* are explained or clarified in the second creation account, to wit:

- Till and keep the land (Garden of Eden, Gen. 2.15)
- The naming of animals (Gen.2.18-19) [vii]

Economic, political, social, and technological developments have increased our human numbers, and lengthened and enriched our lives. However, these developments have led to regional defoliation, dramatic extinction of species, massive human suffering, overpopulation, and misuse and over-consumption of natural and nonrenewable resources, particularly by industrialized societies. This continued course of action jeopardizes the natural heritage that God has entrusted to all generations. Therefore, let us recognize the responsibility of the church and its members to place a high priority on changes in economic, political, social, and technological lifestyles to support a more ecologically equitable and sustainable world leading to a higher quality of life for all of God's creation.[viii]

Leviticus 25:3-5 *Six years you shall sow your field, and six years you shall prune your vineyard, and gather in their yield; but in the seventh year there shall be a sabbath of complete rest for the land, a sabbath for the LORD: you shall not sow your field or prune your vineyard. You shall not reap the aftergrowth of your harvest or gather the grapes of your unpruned vine: it shall be a year of complete rest for the land.*

For most of us it is challenging to look at the earth as our home. We do not feel responsible for taking care of anything that resides outside the wall of our house. Most of us precisely see what it is, just a house and not a home. We find it difficult to differentiate the two, the modern world has created so much need for unlimited worldly possessions that we want to consume more and more every day --- Preservation of Creation is being neglected!

The house is simply a shelter for our heads that acts like storage space to store our material possessions.

Our "*self-centered*" views or perception of life has made us emotionally and ethically detached from our responsibilities towards nature and its inhabitants.

Modernization and advancement are deliberately ignoring to see the consequences of our actions on the environment.

We instead choose to ignore God's finite creation and take much from nature, and fall short of replenishing it.

As stewards we are supposed to take care of our environment. We take from Mother Nature whatever we need ---- We should replenish it so that there will be enough resources left for the next generation.

The earth's resources are finite and fragile, and we have only one world. Thus, we have to take care of our only home and be responsible for it.

Man has been given a unique role of authority and power over all creation. It is important to note that the "dominion" that God gives man is not a selfish mentality but an authoritative-yet-responsible mentality. He has given us great honor in this position.

III. Man Disrupted the Order of Creation

Isaiah 24:3-6 *The earth shall be utterly laid waste and utterly despoiled; for the LORD has spoken this word. The earth dries up and withers, the world languishes and withers; the heavens languish together with the earth. The earth lies polluted under its inhabitants; for they have transgressed laws, violated the statutes, broken the everlasting covenant. Therefore, a curse devours the earth, and its inhabitants suffer for their guilt; therefore, the inhabitants of the earth dwindled, and few people are left.*

Romans 8:22-23 *We know that the whole creation has been groaning in labor pains until now; and not only the creation, but we ourselves, who have the first fruits of the Spirit, groan inwardly while we wait for adoption, the redemption of our bodies.*

The creation principle, then, states that there is a certain order that God ordains for all the elements of creation, human and non-human alike, the altering of which other than that which the Creator had delegated to human beings is sin and thus a disruption to the good balance that was earlier established in the first creation account. This ordering was put in full force by the word of God when the storyteller repeats ten times the phrase, God said (vss.3,6,9,11,14,20,24,26,28,29), thereby implying that before the ten commandments were given to Moses, there was already a greater law of God that governed all of God's creation. The disruption that was brought about by the violation of the law of God in the ordered system installed during creation had unleashed the hidden power in nature that appeared to be the Creator's judgment of sin.[ix]

IV. Christ Mission of both Spiritual Redemption, Reconciliation and Restoration of Earth's Brokenness

Matthew 6:10 *Thy kingdom come, thy will be done in earth, as it is in heaven.*

The constant and fundamental affirmation of the New Testament is that God's rule will ultimately be manifested throughout the entire universe so that redeemed life will be fully experienced on a redeemed earth. The final hope of Christians is not heaven, but participation in God's restoration of all things. While the focus of the kingdom of God in the New Testament is on human redemption, the final restoration of humanity is inseparably linked with the restoration of all creation. The definitive vision of salvation is that of a redeemed community of whole persons set within the context of a restored creation. All creation is the object of God's ultimate redeeming act. [x]

As we pray daily for God's Kingdom to come, we remind ourselves of our responsibilities to our Creator and we maintain the vision of God's glorious future for all who will respond to Him. It is a great future we don't want to miss. So, when we are praying for Kingdom Come, we are praying for this mess humanity has created to be re-made new—something good in God's imagining. Let us willingly submit to Jesus, the leader of God's kingdom. Thus, if we commit ourselves to Him, He will help us be a part of the solution, not the problem.

Disaster Risk Reduction Program Unit

Manila Episcopal Area - United Methodist Committee on Relief (MEA-UMCOR)

References for pages 1-4

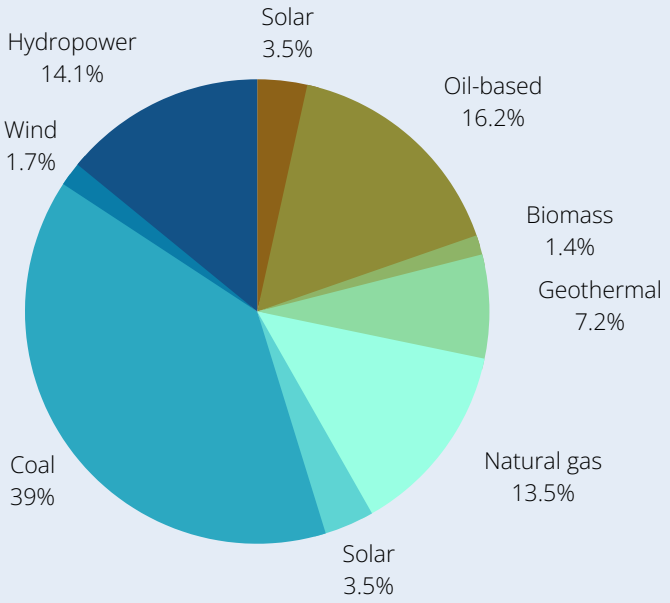
[i] State of the World. worldrevolution.org
[ii] Environmental Degradation. Wikipedia
[iii] Intergovernmental Panel on Climate Change (IPCC) 5th and Naderev "Yeb" Sano (Former Climate Change Commissioner - Confronting The Challenges of Climate Change in the Philippines, 2013
[iv] UMC Social Principles: The Natural World
[v] CLIMATE CHANGE, LIFESTYLE CHANGE by Rev. Rhoneil M. Arevalo Ph.D.
[vi] Care for the Environment Biblico Theological Reflection. MEA DMO | Rev. Catherine Roque
[vii] CLIMATE CHANGE, LIFESTYLE CHANGE by Rev. Rhoneil M. Arevalo Ph.D.
[viii] UMC Social Principles: The Natural World
[ix] CLIMATE CHANGE, LIFESTYLE CHANGE by Rev. Rhoneil M. Arevalo Ph.D.
[x] On this passage, see esp. Paulos Gregorios, "New Testament Foundations for Understanding Creation," in ***Tending the Garden: Essays on the Gospel and the Earth***, ed. W. Granberg-Michaelson (Grand Rapids: Eerdmans, 1987) 84-87.

The Path Towards Energy Transition

The Philippine Electricity Sector

As of June 2020, the Philippines' energy mix is dominated by fossil fuels. Coal has the largest share in the energy mix, comprising 40.43% of installed capacity. Oil-based generation followed with a share of 16.77%, while natural gas contributed 14.00%.

The remainder of the energy mix came from renewable sources of energy. Most of these RE contributions came from old baseload plants such as geothermal and hydroelectric power plants at 7.48% and 14.60% respectively. Contributions from relatively new renewables, such as solar (3.59%) and wind (1.72%), remain very low.



Philippine energy mix as of June 2020 based on installed capacity (Department of Energy)

Our high dependence on imported energy source such as coal and fossil fuel make the electricity price volatile and increasingly sensitive to global market fluctuations. Currently, the Philippines has one of the most expensive electricity rates in Asia.

The dominance of dirty energy sources also leads to increased greenhouse gas emissions. In 2010, the power sector contributed to 37% of the country's total GHG emissions.

In 2018, total greenhouse gas (GHG) emission from energy-related activities reached 123.3 million tons of CO2 equivalent (MtCO2e) with power generation contributed to more than half of the emissions at 51.7%. This high figure is very alarming since power generation accounts for only 41% of energy-related GHG emissions at the global level.

Crossing Over: Energy Transition Towards Renewable Electricity

The devastation of many communities caused by climate change, and the raising environmental consciousness are pushing global citizens, especially the youth, to demand accountability from all governing states to act.

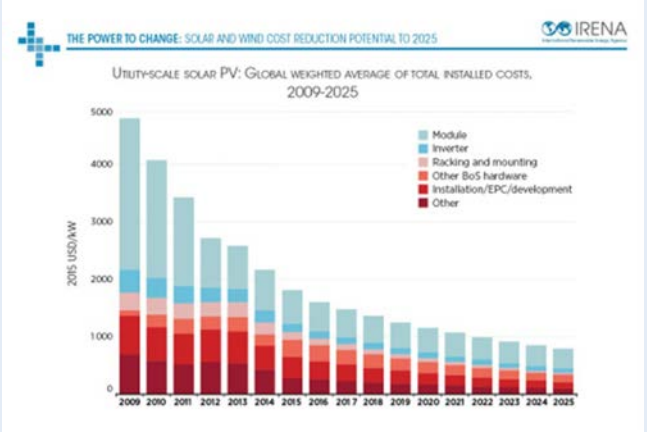
There is a growing movement to push for clean and renewable energy systems, and replace the conventional power sector dominated by coal and fossil-fuel sources. Prices of renewable energy technologies keep on declining while coal prices increase due to hefty levies and pressure to decarbonize the electricity sector.

The energy future will be dominated by cheap but highly efficient renewable technologies. And this RE trend is already happening now! Solar power generation started in 2005 but it has an average annual growth rate (AAGR) of 4734.62% in the past five years. Wind generation, which also started in 2005, has a 514.03% AAGR. Renewable energy can help achieve 100% electrification and reach even the last-mile communities. To date, more than 12 million Filipinos still lack access to electricity.

The newly-enacted Energy Conservation and Efficiency Law also encourages all sectors to implement energy management programs to conserve electricity and lessen energy losses. By doing this, consumers recover savings and also lessen their own carbon footprint.

Innovations in renewable energy technologies are shifting to decentralized systems. More and more electricity consumers are opting to put up their own solar PV rooftop and produce their own power. These "prodsumers" help revolutionize the power sector by interjecting more clean energy into the electricity mix.

Let's join the clean energy movement. The time to cross-over is now!



Energy Management and Conservation

What is Energy Management?

Energy management is a cost-effective and proactive solution to track, optimize and save energy, and in the process mitigate climate change. Energy management can include the following:

a. Monitoring the quantity and pattern of energy use;
b. Quantifying reduction of energy consumption; and
c. Implementing measures to decrease energy requirements without sacrificing productive applications and services.

Managing energy consumption will first and foremost require a fundamental change in mindset. It may start from simple actions such as turning off appliances, using energy-saving devices and appliances, such as LED bulbs for lighting or highly efficient variable frequency motors (known as inverter motors) for air conditioning and refrigeration.

Energy management also involves looking at the big picture, such as making investments in retrofitting building envelope and cooling systems, financial modelling and planning to estimate future operational cost reduction targets, and/or tapping accredited Energy Service Companies (ESCOs) to facilitate your energy audits and planning.

Concepts of Energy Management

There are two general concepts of Energy Management, primarily:

Energy Conservation. Focuses largely on behaviors and actions that result in a reduction in energy use. For example, by switching the lights off inside an empty room or unplugging appliances that are not in use, a consumer saves energy from being wasted, and makes it available to carry out other necessary services or productive tasks.

Energy Efficiency. Primarily relates to the goal of reducing the amount of energy needed to provide the same level of services and output. Simply put, energy efficiency aims to eliminate energy waste. It also refers to the various measures (technical and non-technical) applied to processes and activities to reduce energy consumption.

To illustrate, replacing a 40 watt (W) incandescent bulb with a 6W LED lamp that provides the same level of illumination will result in energy savings of 34 watt-hour (Wh) and consequently, a reduction on the energy bill. The replacement or upgrade of technology may incur some initial costs for the consumer, but these costs may be comparatively lower versus investments required to increase generation capacity

Practical Tips and Tricks to Reduce Energy Consumption

Here are some practical tips to reduce your energy consumption at home, school or in your business establishment.

Air Conditioners

1. Ensure that the cooling capacity of the air conditioner matches the required cooling load for the space or room. Basing the capacity primarily on the floor area alone, a room or space with a floor area of 18 m2 will require a 1.0HP air conditioning unit.
2. Understand the different operating modes for the air conditioners and how such operating modes affect cooling performance and electric power consumption. Air conditioning units from different brands may feature different modes or have different names for the same operating modes.
3. Follow prescribed maintenance schedules and clean the air conditioner filters. Clogged air filter reduces airflow and forces the air handler to work harder in pushing air through the appliance for cooling and ventilation. As a consequence, the cooling efficiency decreases and energy consumption increases.
4. Consider upgrading to highly efficient variable frequency motors for air conditioning and refrigeration (more popularly known as inverter appliances). Based on MERALCO Power Lab tests, inverter based cooling technologies can generate savings ranging from 25% to 62%. For a 1.0HP unit, the equivalent monetary amount can be around PHP504.00 per month.
5. Reduce the amount of floor area to be cooled by the air conditioner and the potential heat gains from windows and doors.
6. Always compare and select air conditioner units based on the computed Energy Efficiency Ratio (EER). High values of the EER (for the same cooling capacity) usually corresponds to potentially lower the operating costs. Figure 11 presents a sample of the energy label for air conditioning units.

Cooling Mode

Default operating mode for any air conditioner. The thermostat setting on the air conditioner dictates the amount of energy consumption resulting from the periodic cycling of the compressor in order to maintain the room temperature. Available technical studies recommend setting the air conditioner thermostat to the 25 ℃ mark as a way of ensuring energy efficient operation while providing adequate comfort for occupants.

Cooling: High | Power Saving: Moderate

Fan Mode

Operating the air conditioner in Fan Mode switches OFF the compressor and in effect, the cooling functionality of the appliance. In this mode, the air conditioner will only provide ventilation and air circulation at a low amount of energy consumption.

Cooling: Minimal | Power Saving: Very High

Power Saving or Energy Saver Mode

This is a built-in air conditioner operating mode included as one of the energy conservation features of the appliance. Different manufacturers implement the Energy Saver Mode in a variety of ways: (i) Some program the air conditioner to automatically adjust the temperature a few degrees higher than the thermostat setting selected by the user. When the air conditioner reaches the set temperature, the compressor switches OFF, but the fan continues operating. The adjusted temperature setting means that the compressor will run for shorter durations, reducing energy consumption; (ii) Manufacturers may also implement the operating mode by switching both the compressor and fan OFF when the thermostat reaches the temperature set by the user; and (iii) Other manufacturers may also switch both the compressor and fan OFF when the thermostat reaches the temperature set by the user and a timer to switch both the compressor and the fan ON.

Cooling: Moderate | Power Saving: Very High

Quick Cool or Turbo Mode

The operating mode runs the air conditioner at maximum capacity until the thermostat cools down to 16°C or 17°C and as a consequence, consumes the highest amount of energy.

Cooling: Very High | Power Saving: Low

Dry or High Humidity Mode

The Dry or High Humidity Mode removes the extra humidity or moisture in a room by cycling the compressor ON and OFF for short periods of time, while continuously running the fan at low speed. The operating mode will be useful for temperate areas with high humidity or during the monsoon season in tropical locations.

Cooling: Low | Power Saving: Moderate

Sleep or Night Mode

The operating mode has been designed to keep the room temperature comfortable and reduce energy consumption during sleeping hours. Turning the operating mode ON will increase the temperature by 0.5°C to 1°C every hour to prevent overcooling (people normally require less cooling while asleep).

Cooling: Moderate | Power Saving: High

Electric Fans

1. Use the appropriate fan speed to ensure both thermal and noise comfort of occupants within the room or space. Setting the fan speed to high will not only increase energy consumption, but may also distract or annoy people due to the noise or excessive air flow created by the fan.
2. Follow prescribed maintenance schedules and clean electric fan parts. Accumulated dust reduces airflow and forces the motor to work harder in pushing air through the fan blades and increases energy consumption.
3. Occasionally open the motor housing for cleaning and lubrication to lessen the chance of the fan overheating and consuming more energy.

Television

1. Watch together, instead of watching different programs on different television sets and multiplying the energy consumption. Use the energy saving operating mode for televisions installed with this function.
2. Always unplug unused appliances to eliminate costs associated with the consumption of stand-by power. The 32" LED television mentioned above and plugged in consuming stand-by power may result to additional costs to the electric bill ranging from PHP5.00 to PHP10.00 per month or around PHP10.00 to PHP15.00 per month for older models on stand-by power.
3. Consider upgrading to more energy efficient models, such as LED televisions, that can save up to 77% of energy costs per month with a better viewing experience. Select the appropriate size when purchasing a new television. The larger television size, the higher the required operating wattage, resulting to a higher consumption of energy and associated costs.

   Recommended Television Size = (Viewing Distance (in inches)) / 2

Refrigerators

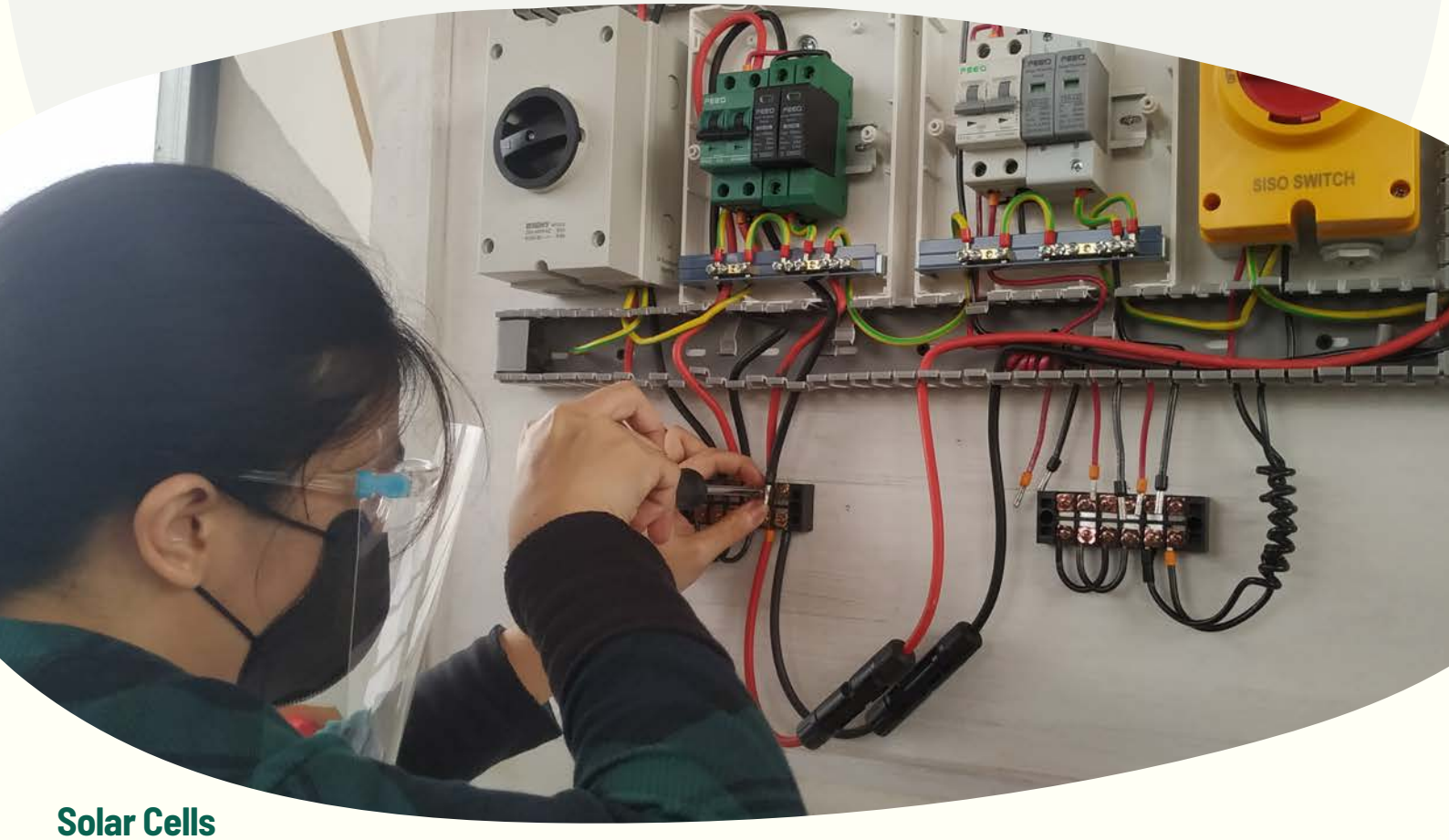
1. Always compare and select refrigerator units based on the computed Energy Efficiency Factor (EEF). High values of the EEF usually corresponds to potentially lower operating costs. Figure 12 presents a sample of the energy label for refrigerator units.
2. Make sure to purchase an appropriately-sized unit based on the number of family members or users of the refrigerator unit. 7 to 10 cubic feet refrigerator units will generally have enough capacity for two (2) people. Add an extra cubic foot of capacity for each additional person or user.
3. Provide proper air circulation and placement based on the recommendation and instructions of manufacturers. Allow for a 1.5" to 2" clearance on all sides of the refrigerator to ensure proper airflow to prevent overworking the motor and efficiently reduce heat from the condenser coils. Do not position the refrigerator near heat-producing appliances or expose it to direct sunlight.
4. Keep the refrigerator full, but not overloaded, to allow for the proper circulation of cold air. Overfilling the refrigerator hinders airflow, effectively reducing efficiency and increasing energy consumption. The internal temperature of the refrigerator should be between 2°C to 3°C and -18°C for the freezer.
5. Always mind the door and other seals/gaskets. Repeated opening of doors increases the heat gain inside the unit reducing the operating efficiency and increasing energy consumption. In addition, air infiltration and leakages will require additional energy to maintain the internal temperature.
6. Consider upgrading to highly efficient variable frequency motors for air conditioning and refrigeration (more popularly known as inverter air conditioners or refrigerators). Based on MERALCO Power Lab tests, inverter based cooling technologies can generate savings of up to 50%.

Solar PV Rooftop

Solar energy is the radiant light and heat coming from the sun. Solar energy is crucial for plants and trees to generate their food, circulate air, regulate global temperature and make life exist in the planet. Humans have been harnessing energy from the sun for centuries. However, the advent of technology helps us convert solar energy into electricity to be able to power our homes, provide lighting, drive appliances and increase our economic production.

As a tropical country, all areas of the Philippines receive an ample amount of solar radiation, making solar energy a viable and practically unlimited energy source that can be tapped by any community. The Philippines has an average of four (4) sun-hour, or the number of hours in a day when solar radiation reaches its peak value of 1000 watts per meter squared or 1kW/m2. In Europe, where the use of solar energy for electricity was first popularized, most areas only receive an average of less than 2 sun-hour.

There are different ways to harness solar energy and use it for our day-to-day. However, the technology of solar photovoltaic (PV) are becoming the most popular and widely use due to its declining prices and wide range of application.



Solar Cells

Solar photovoltaic technology utilizes the photovoltaic effect or converts light (photons) to electricity. This process happens through the use of photovoltaic cells or "solar cells". When solar light hits the cell, it causes an electric flow. The greater the solar intensity, the greater the flow of electricity. If it's cloudy or rainy, electricity production is very low. No electricity is produced at night due to the absence of solar radiation.

Solar cells are then arranged in a group to form a solar PV module or simply, a solar panel. Glass protects the cells from dust, water and other elements. A small junction box is attached to the back of a solar PV panel to provide an output interface. Most solar panels that are rigid but semi-flexible, and made of thin-film cells are becoming popular. However, rigid solar panels, especially the monocrystalline type, has higher efficiency than thin-film solar panels.

Solar panels produce a unidirectional flow of electric charge or what's commonly called as Direct Current (DC). Solar panels have a negative (-) terminal and a positive (+) terminal. Panels are arranged either in a series to achieve a desired output voltage (V, volt) or in parallel to achieve a desired current output (A, ampere).

Benefits of Solar PV Rooftop

There's an increasing trend in installing solar PV systems due to high electricity costs, declining prices of solar PV devices, and growing environmental consciousness among citizens. For urban centers where space is limited, rooftops provide an adequate area to place solar panels and harvest the energy from the sun.

The sun is a clean and free source of energy. Solar PV systems do not require fossil fuels to operate; therefore, it has no emissions and do not emit toxic pollutants into the environment. Solar PV offsets the demand for electricity coming from coal and other dirty sources, hence it reduces greenhouse gas emission into the atmosphere. Depending on the capacity, solar PV can be installed in a rooftop between 1-5 days.

Users of solar PV rooftops become "prodsumers": they enjoy the benefit of producing their own power while still maintaining the services of their respective private distribution utility or electric cooperatives (DUs/ECs).

Electricity produced by a solar PV rooftop is the cheapest among all energy sources, as shown by an analysis called Levelized Cost of Electricity (LCOE). Based on CREST's computation, the LCOE for solar PV rooftop is at 5.01 pesos per kiloWatt per hour (CREST, 2019). This amount is significantly lower compared to the retail electricity price from an electric distribution utility, e.g. Meralco (PUT PRICE HERE, SAY "CURRENT PRICE).

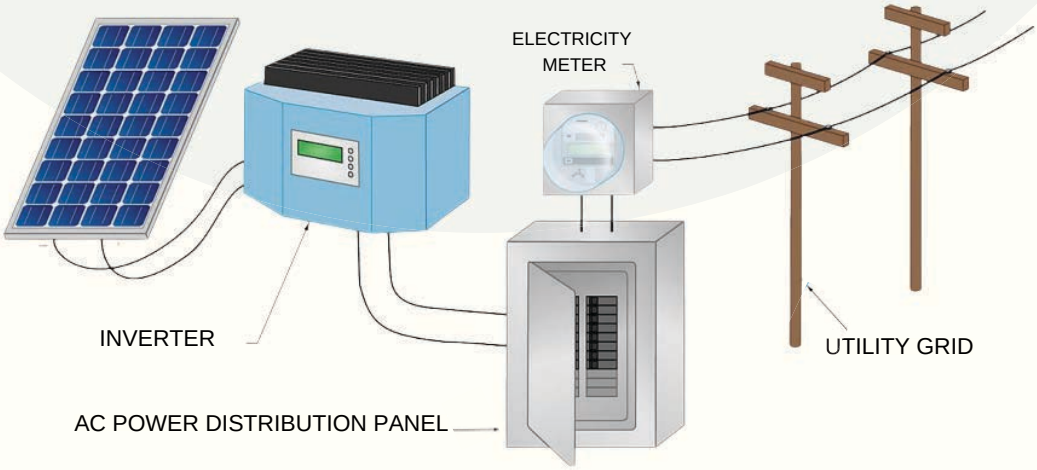
Solar PV systems can be used to provide power even in far-flung islands or communities. It can also be used in a wide range of application such as agriculture production, irrigation, emergency and disaster response, transport and others.

Different Solar PV Designs

Grid-tie Solar PV

The most popular solar PV rooftop design for Metro Manila and urban centers is the grid-tie solar PV. This system is utility-interactive and the electricity produced by the solar panels blend with the electricity coming from the DUs/Ecs.

This system utilizes only two main devices: *solar panels* and a *grid-tie inverter*. A grid-tie system is rated based on the total power of the solar panels in an array. For example, if you have a total of 800W panels, the inverter should be at least 800W or with a higher capacity. An inverter is a device that converts the panel's direct current to non-directional, alternating current (AC), so that the produced electricity can be used by common household appliances. A grid-tie inverter has an anti-islanding protection. It is a safety feature that automatically disables the inverter's PV features if it detects that there is no grid electricity. It means your solar PV rooftop will not work during blackouts.



Off-grid Solar PV

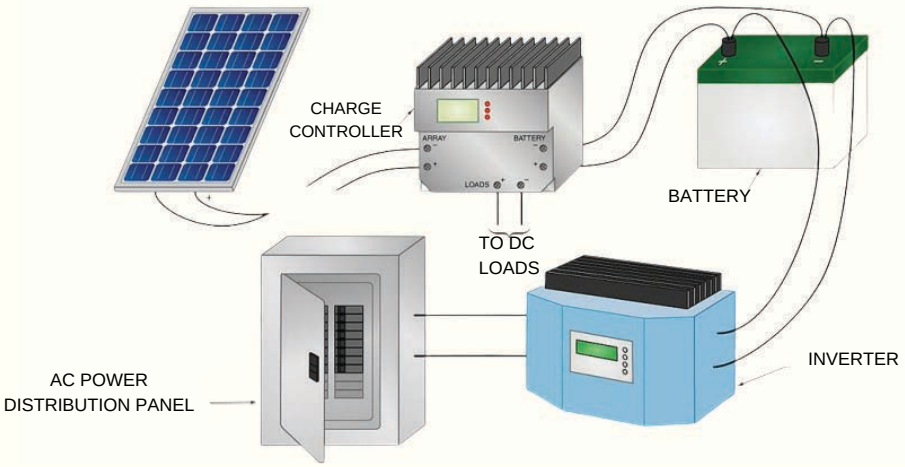
This is a stand-alone system and can be set-up anywhere. It has a wide-range of application, such as providing electricity in remote areas, street lighting, charging station, water irrigation, transportation, and others.

Off-grid solar PV has four main devices: solar panels, an off-grid inverter, a charge controller, and a battery. The electricity from the solar panels flows into the charge controller, then to the battery. The charge controller acts as the electricity regulator to control the charge and discharge of the battery. Similar from the previous design, an off-grid inverter converts direct current to alternating current.

The battery is a device where you store electricity for use especially at night. It is rated in Ampere-hour or Ah. The higher the Ah of the battery, the more electricity that can be stored. The most common type of solar battery in the market is the lead-acid. Depending on the depth of discharge, a lead-acid battery has 200 to 300 charge cycles. The more efficient but costlier lithium-ion solar battery has 300 to 500 charge cycles. Batteries are arranged either in a series or parallel to achieve the desired output voltage, e.g. 12V, 24V or 48V.

Off-grid solar is rated based on the total power capacity of solar panels and battery array. Solar panels are connected either in series or parallel to get the desired voltage and ampere of the system. Users should use a charge controller with higher capacity than the voltage and ampere output of solar panel arrays. A charge controller should also match the voltage output of your battery array.

Users of off-grid solar PV can enjoy its benefit 24-hours, seven days a week. However, it is costlier and require more maintenance because of the use of batteries.



Source of graphics in this page: American Technical Publishers

Hybrid Solar PV

This system combines both the function of grid-tie and off-grid systems. Users enjoy the benefits of solar during daytime and have a battery system that still power critical loads during blackouts. When we say critical loads, these are important devices in times of emergencies such as lighting, charging stations or refrigeration for medicines and vaccines.

Due to its function, hybrid solar PV systems are usually put in buildings where having backup power is very important such as emergency and DRR Centers, evacuation facilities, hospitals, rural health units, etc.

Hybrid solar PV is the costliest among the three mentioned systems. It also requires more user monitoring and maintenance.

Technical Considerations

Here are other considerations when putting up a solar rooftop.

Before installation

- Grid electricity must be available if you plan to put up a grid-tie or hybrid solar PV system.
- Assessment of the roofing structure is very critical to determine if it can carry the weight of the panels. A 400W solar panel weighs roughly 10-15 kilograms. Installation of solar panels must be avoided in roofs with advanced rusting and physical deterioration.
- Ensure that there is an appropriate rooftop area for the panels. On an average, a 1kW solar PV requires an area of 10 square meters.
- Identify the area of the roof where there are no/limited shadows coming from nearby trees, buildings or any physical structure, e.g. chimney.
- Purchase your solar equipment from reliable solar suppliers that offer a good warranty period for their products.
- For first time users, it is better to look for a reliable solar service company to help you in your grid-tie solar PV installation.

During installation

- When installing a solar PV system, ensure that all solar panels can be accessed individually for cleaning and maintenance.
- It is ideal to install the panels facing south to maximize the amount of sunlight.
- Inverters and other system components must be located in a secure space of the house and out-of-reach of children. Devices must be placed as close as possible to each other.
- Coordinate with your distribution utility or electric cooperative to apply for a net-metering program.

Operations and Maintenance

- Clean the panels at least once a year with soft/non-abrasive wet rags or towels to remove accumulated dust and dirt. For highly polluted areas, it might be necessary to clean more often. Use soap to scrub off grease and dirt. Clean thoroughly with water afterwards.
- Regularly monitor the power production of the system. New inverters also have smart functions so that users can monitor the performance of their solar PV system even if they are away.

The Manila Episcopal Area Disaster Management Office (MEA DMO) was established to coordinate area-wide efforts on disaster preparedness, response, prevention, and mitigation through the support of the United Methodist Committee on Relief (UMCOR). MEA DMO aims to strengthen and transform communities and its people, and our thrust is to re-affirm our stewardship calling, consolidate best practices, and strengthen the structures toward disaster risk reduction to fulfill the vision and mission of UMCOR.

United Methodist Committee on Relief (UMCOR) is a non-profit humanitarian relief and development arm of The United Methodist Church. UMCOR comes alongside those who suffer from natural or human-caused disasters – be it famine, hurricane, war, flood, fire and other events – to alleviate suffering and to be a source of help and hope for those left most vulnerable. UMCOR's work reaches people in more than 80 countries.

Address: 3rd Floor UMC Bldg., 900 United Nations Avenue, Ermita, Manila 1000
Phone: +63 8423 1373
Email: meadmo-umcor@pccumcmanilaea.org

The Center for Renewable Energy and Sustainable Technology (CREST) is a non-profit organization working towards sustainable energy transition and away from dirty energy facilities such as coal. CREST also supports cities and communities develop their own renewable energy programs and access affordable climate systems.

Address: 69 Bansalangin Street, Project 7, Quezon City 1105
Phone: +63 2 79 71 46 21
Email: crestphilippines@gmail.com

"The adverse impacts of global climate change disproportionately affect individuals and nations least responsible for the emissions. We therefore support efforts of all governments to require mandatory reductions in greenhouse gas emissions and call on individuals, congregations, businesses, industries, and communities to reduce their emissions."

(UMC Social Principles, ¶160.D)

Manila Episcopal Area
Philippines Central Conference
THE UNITED METHODIST CHURCH

DISASTER RISK REDUCTION PROGRAM MANAGEMENT
Prevention & Mitigation
Preparedness
Emergency Response
Recovery & Rehabilitation
EVENT

Supported by:
UMCOR

CREST