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Energy Democracy

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Equal

Just

Fair

Energy Democracy

Democracy

Food

Water

Energy

NEED

How a need can be democratic !!

Demand

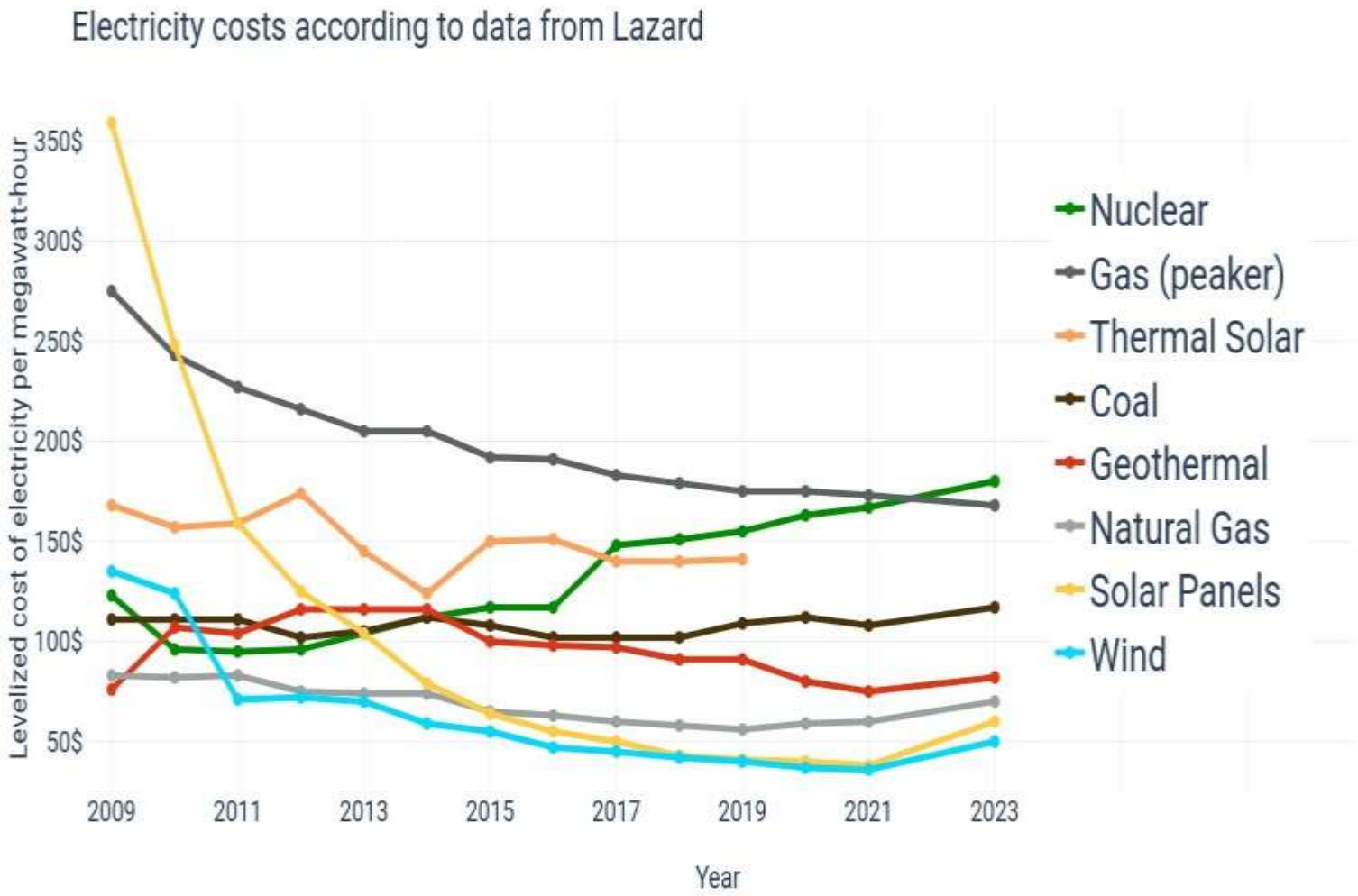
Accesible for everyone in need/

Production

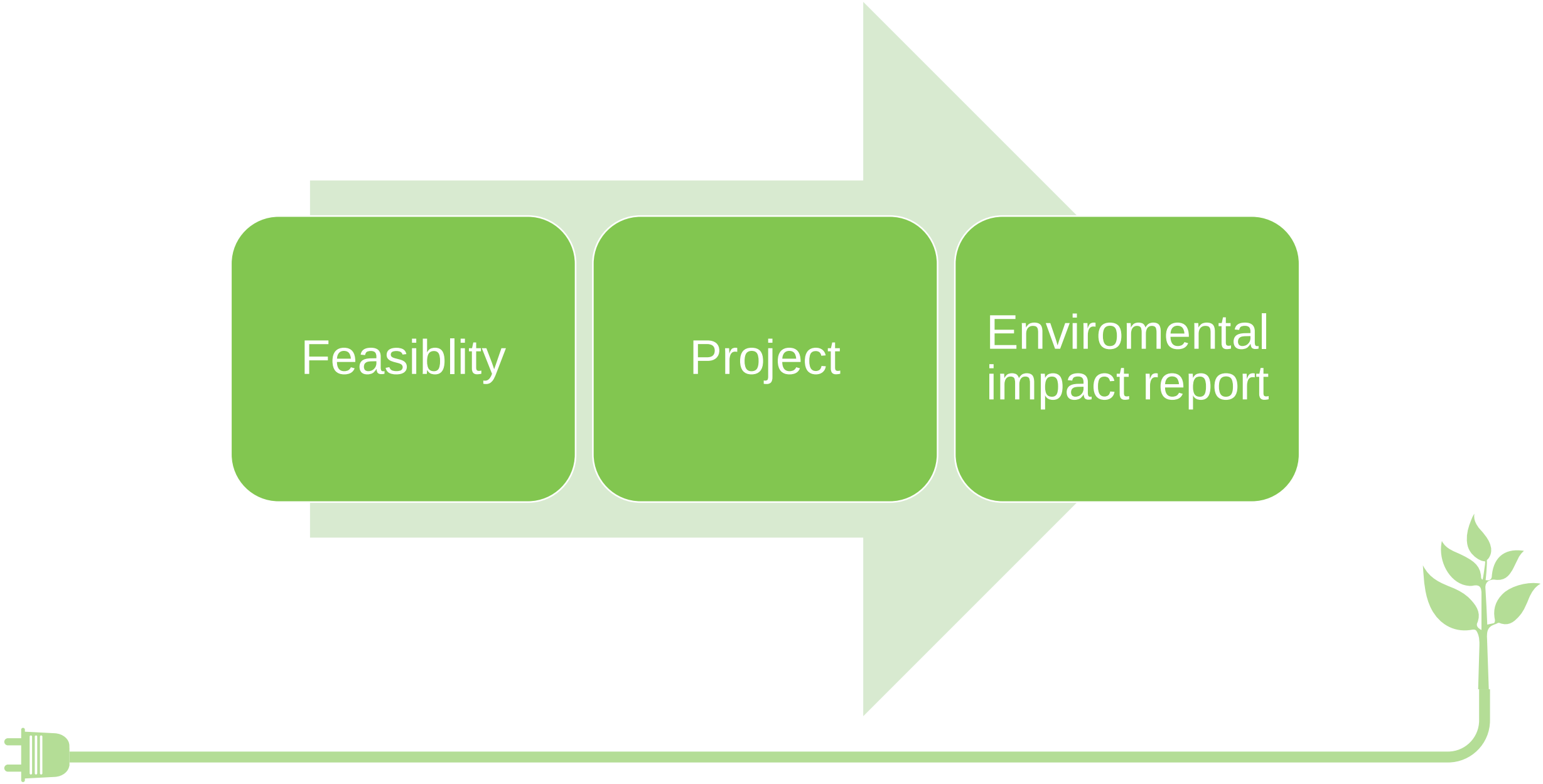
Safe and fair.

Next Generations

Leaving sustanible earth

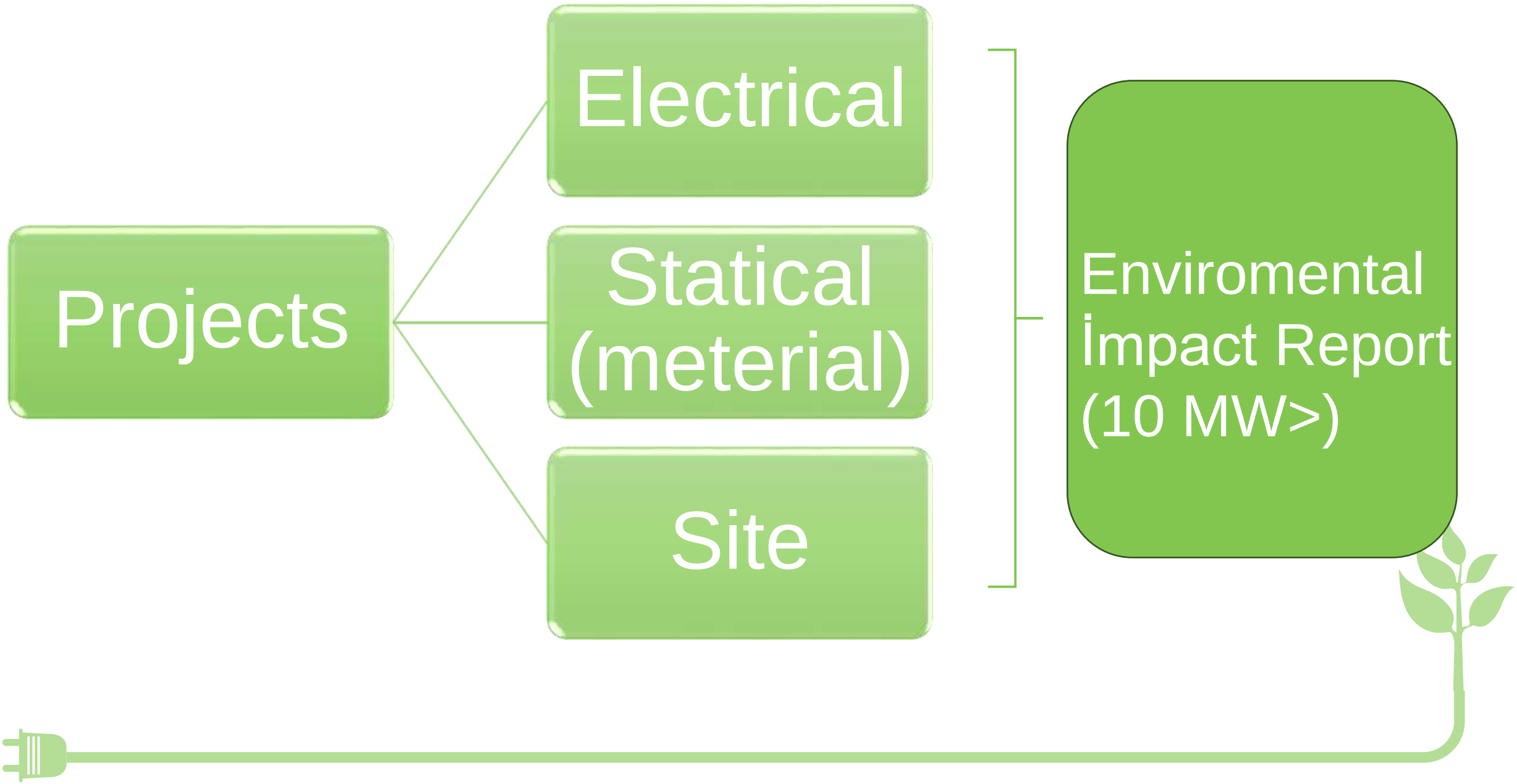


- Energy markets acts as stock markets
- Mostly always about cost efficiency
- Energy democracy trend becomes more favorable after 2015


Feasiblity
Project
Enviromental impact report

Feasibility

- What is needed (energy type, amount of energy)
- Cost effciency calculation for each possible type of production
- Area, space etc....


Projects
Electrical
Statical (meterial)
Site
Enviromental İmpact Report (10 MW>)

What is the Energy

Energy – The ability to cause a change in matter

Law of Conservation of Energy – Energy can never be made or destroyed, but it can change forms

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Types of Energy

Chemical Energy
Energy that is available for release from chemical reactions.

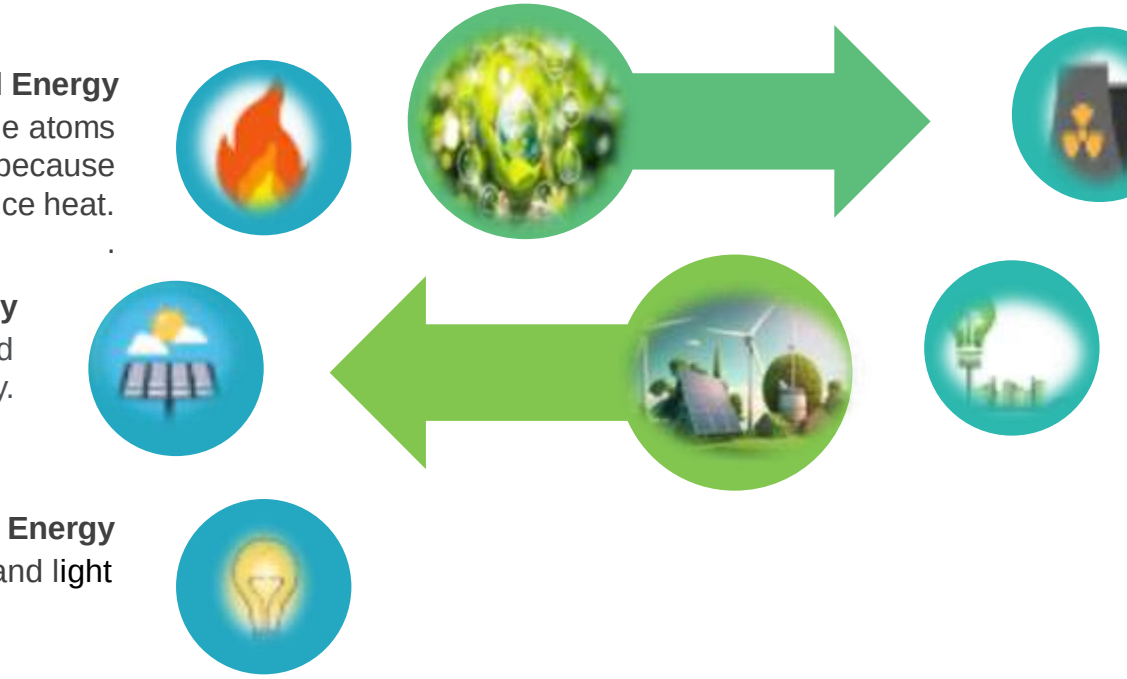
Nuclear Energy
When the nucleus splits (fission), nuclear energy is released in the form of heat energy and light energy.

Electrical Energy
Energy caused by the movement of electrons

Thermal Energy
The internal motion of the atoms is called heat energy, because moving particles produce heat.
.

Kinetic Energy
The energy of motion is called kinetic energy.

Electomagnetic Energy
X-rays, radio waves, and light



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- Heaters that make a room warmer
- The sun drying wet clothes on a clothesline, Ironing a shirt
- Baking a cake
- Warming water to make tea

Thermal Energy

Electrical Energy

Easily transported through power lines and converted into other forms of energy

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Power Plants

Electrical & Thermal Energy

Energy conversion refers to the process of conversion from one form of energy to another. This conversion usually occurs between different energy sources or in energy storage and power plant systems.
Fuels are generally used to produce heat or electricity.

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Energy Sources

01

Renewable Energy

Energy obtained from constantly renewed and inexhaustible sources in nature

02

Non-Renewable Energy

They are energy resources that exist in limited amounts in nature and are at risk of depletion. Non-renewable energy sources are often called fossil fuels and can cause problems such as environmental impacts and climate change.

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Renewable Energy

Hydro Energy

It is obtained by converting the potential energy of water in streams or rivers into electrical energy through hydroelectric power plants.

Solar energy

It is achieved by converting sunlight into electrical energy through solar panels.

Biomass Energy

It is the energy obtained by burning or fermentation of organic materials (biomass).

Wind Energy

It is achieved by converting the kinetic energy of the wind into mechanical energy and then into electrical energy with wind turbines.

Geothermal Energy

It is the energy obtained by using hot water and steam underground.

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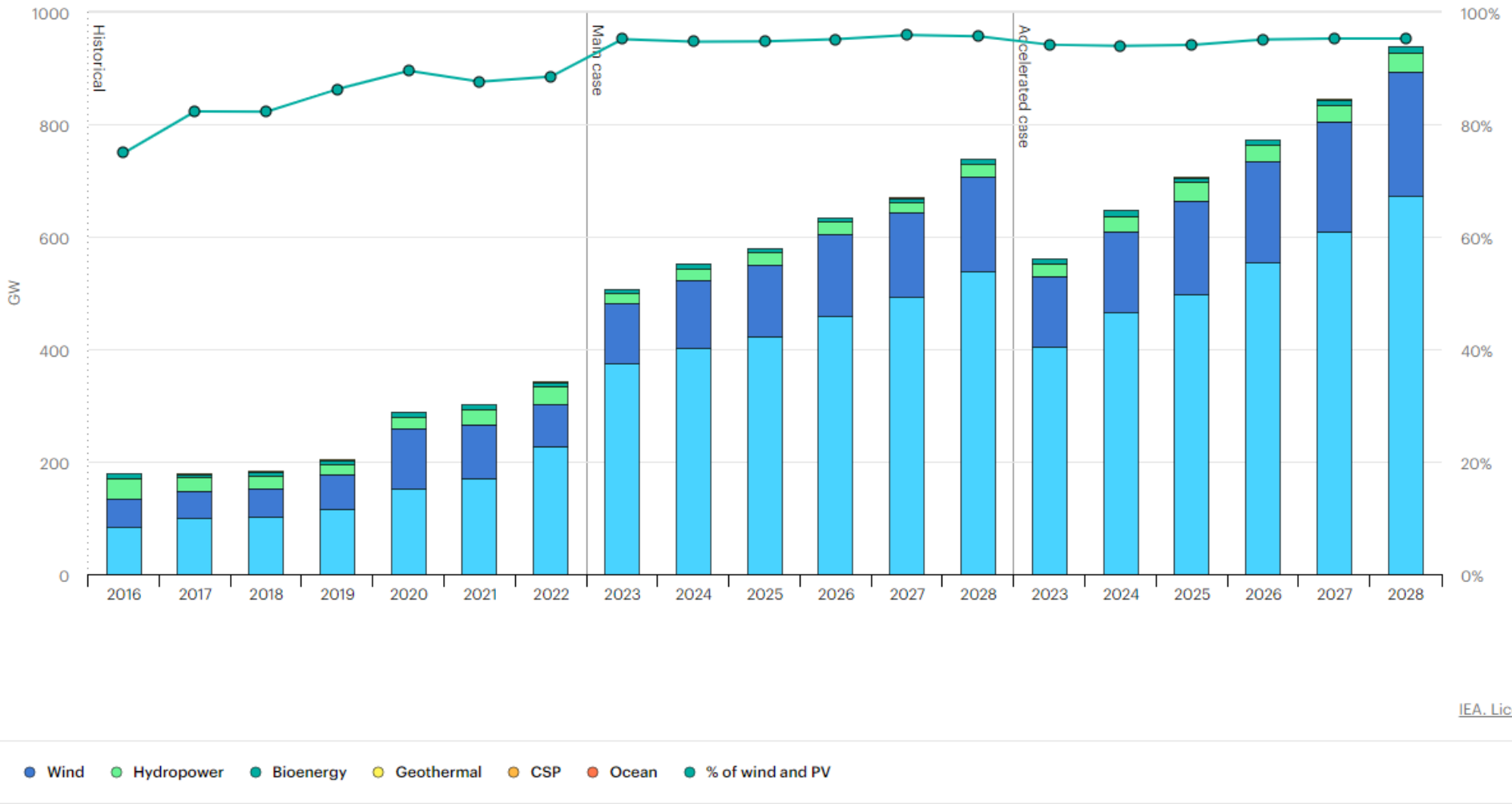

Distrubition

Renewable Energy

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Why R.E.?

01 Fossil Fuels

Fossil fuels are non-renewable, that is, they draw on finite resources that will eventually dwindle, becoming too expensive or too environmentally damaging.
Also increasing oil prices.

02 Pollution

New resarch found that more than 8 M people dies in 2018 from fossil fuel pollution,
Fossil fuel comsumbtion results in pollutants that contribute to land degradation.

03 Climate Change

Burning fossil fuels such as coal releases carbon dioxide and other greenhouse gases.
These gases trap more of the sun's heat in our atmosphere, causing climate change.

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Solar Energy

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Solar Energy

Clean Energy, Easily avaliable, Flexible location.

- Solar energy is the energy received by the earth from the sun.
- Solar energy is in the form of solar radiation, which makes the production of solar electricity.

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Solar Energy Applications

Passive Solar Gain

Using building materials that store heat.

Solar Thermal

A solar thermal panel is simply a black surface that absorbs light, heats up and transfers the heat into working fluid.

Concentrated Solar Power

The sun’s rays are concentrated by mirros, much higher temperatures can be created.

Photovoltaic Solar

PV cells concert light directly into DC electircity.

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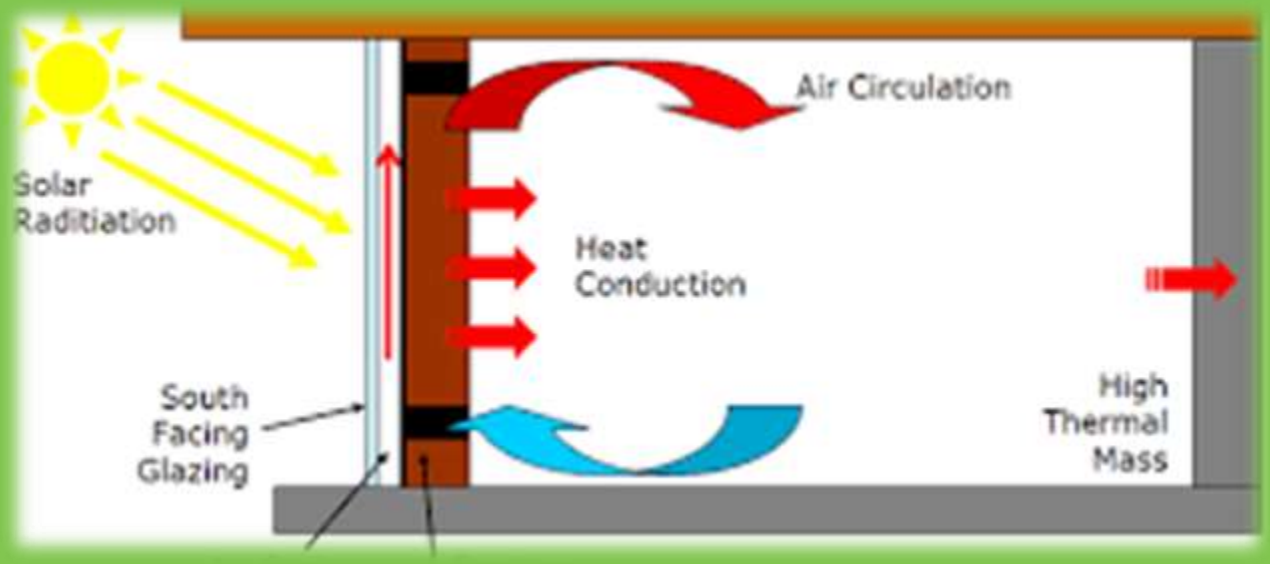
Passive Solar Gain

Passive solar energy is one of the methods designed to heat or cool a structure by directly using sunlight and heat.



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Solar Thermal

Solar water heating systems are systems designed to produce hot water using solar energy. These systems often capture sunlight using photovoltaic panels or solar thermal collectors and use it to produce hot water.

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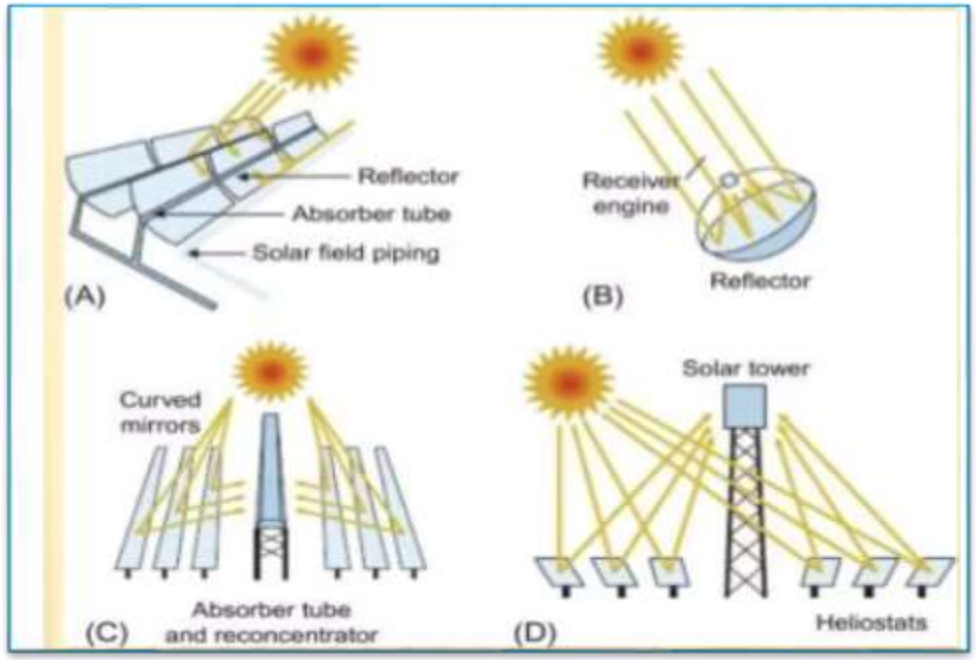

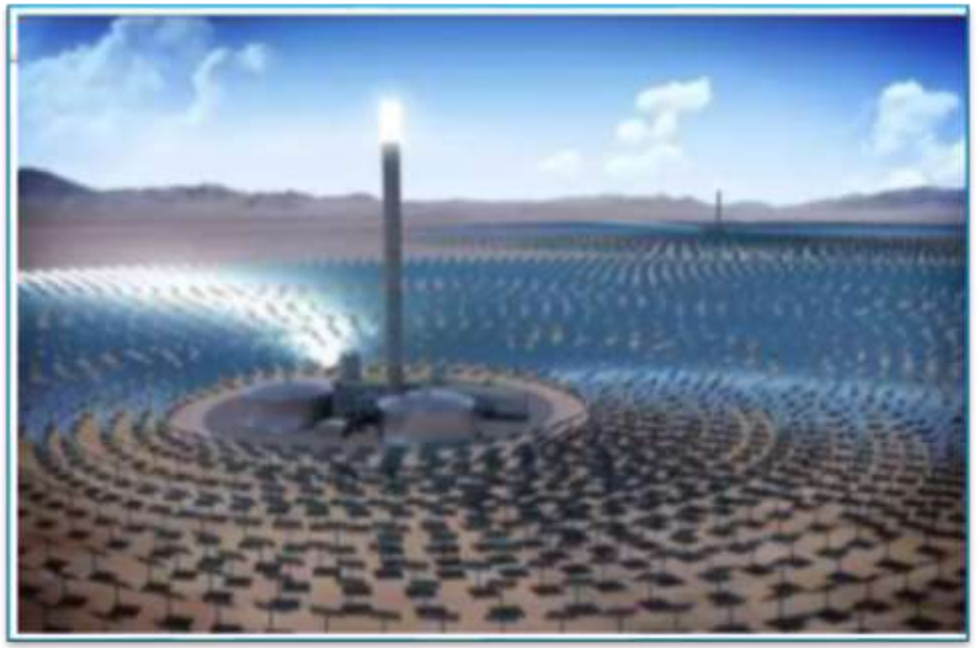

Concentrated Solar Power

Concentrated Solar Power (CSP) means concentrated solar energy. This technology captures sunlight using mirrors or lenses that concentrate sunlight onto a focal point and uses it to convert that light into heat or electrical energy.

CSP technology can be used for large-scale electricity generation, especially in regions with abundant sunlight. These systems can be integrated into electrical grids and are considered a clean and renewable energy source. Additionally, they can be used together with energy storage systems to ensure continuous and stable use of solar energy. However, CSP systems have high installation costs and some local environmental impacts.

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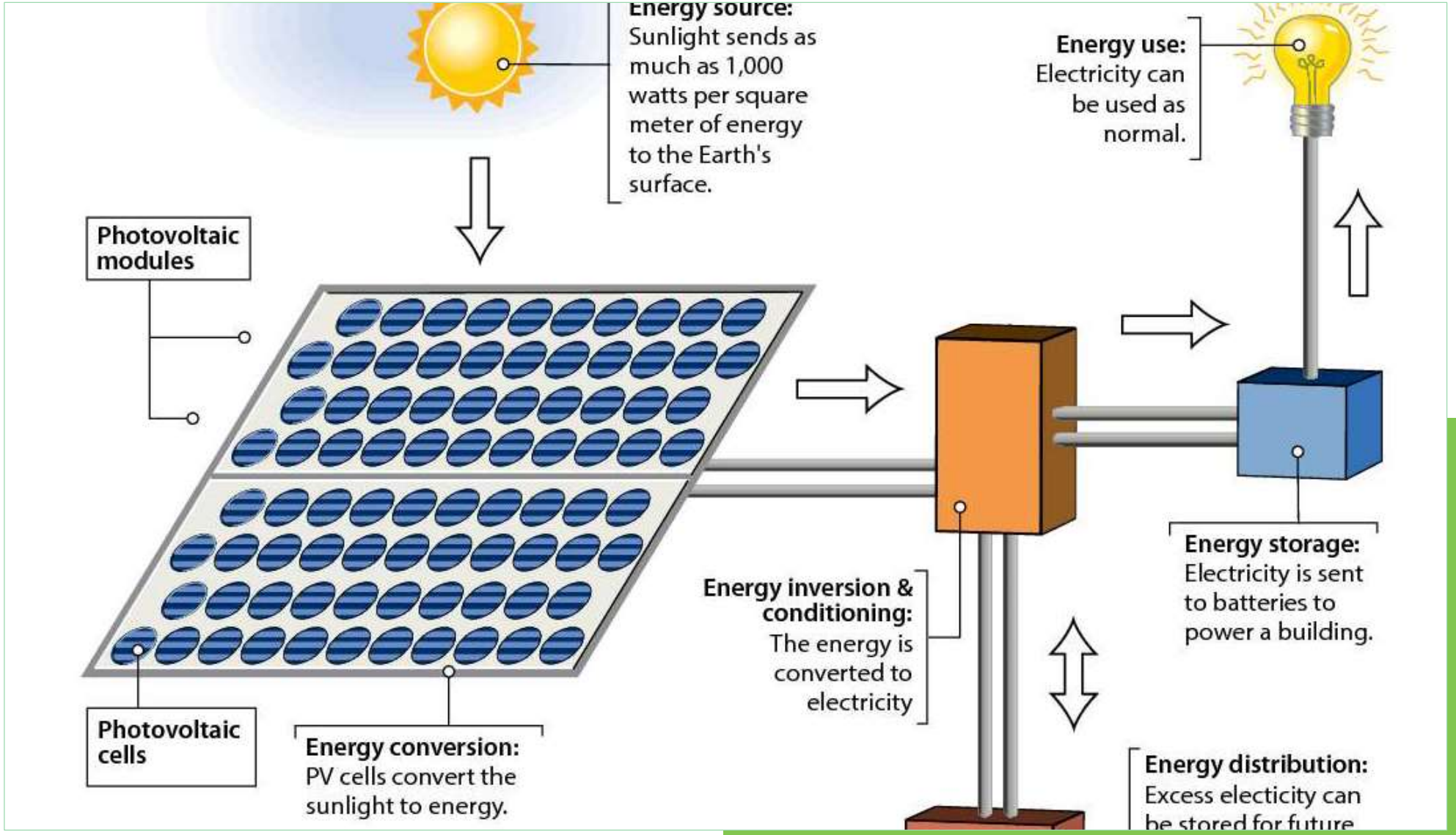
Working Principle

PV Panels



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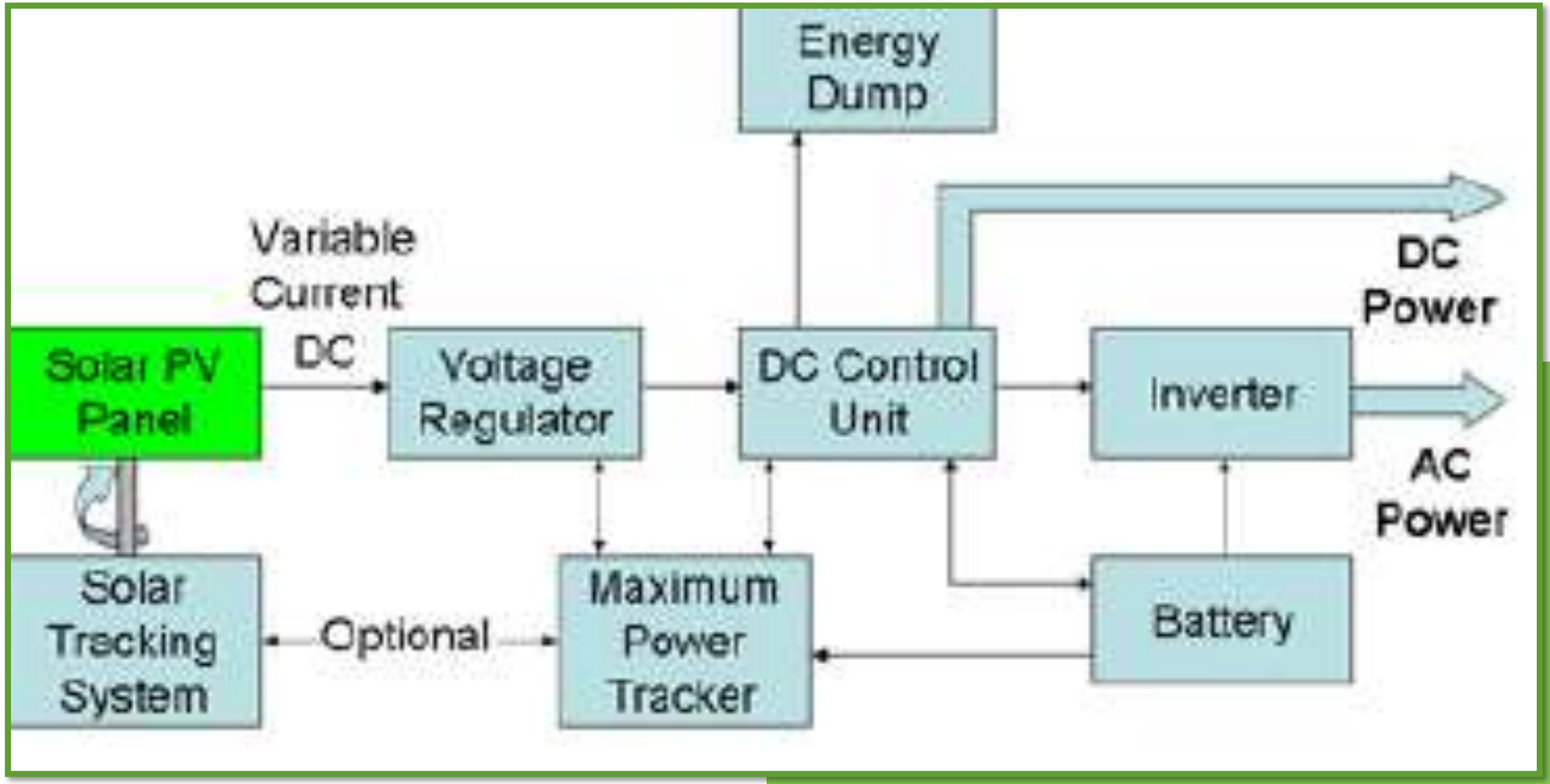
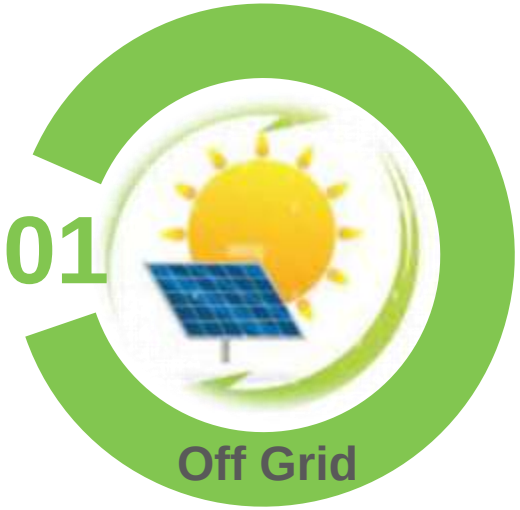
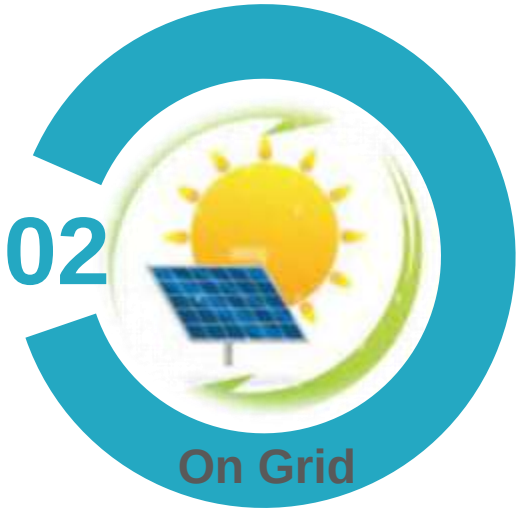


PV Panels

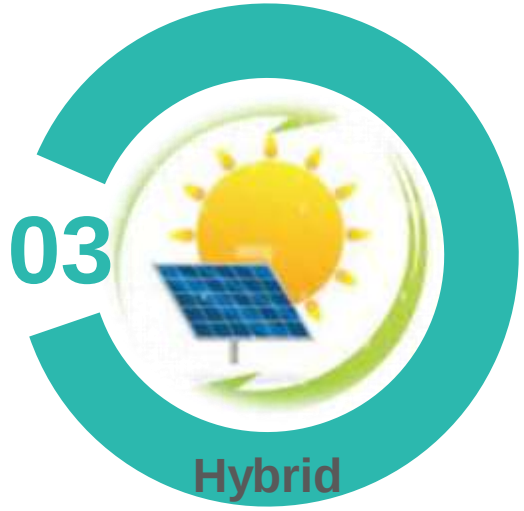
TYPES F PV SYSTEMS



An off grid or stand along solar PV system is when solar PV system is not connected to the utility grid and we are producing own electricity via solar is called off-grid solar system.



On-grid systems are linked with power utilities, which enable the home to use the power generated by the solar system as well as power from the local utility.



System

Hybrid systems consist of combination of PV modules and a complementary means of electricity generation such as a diesel, gas or wind generator

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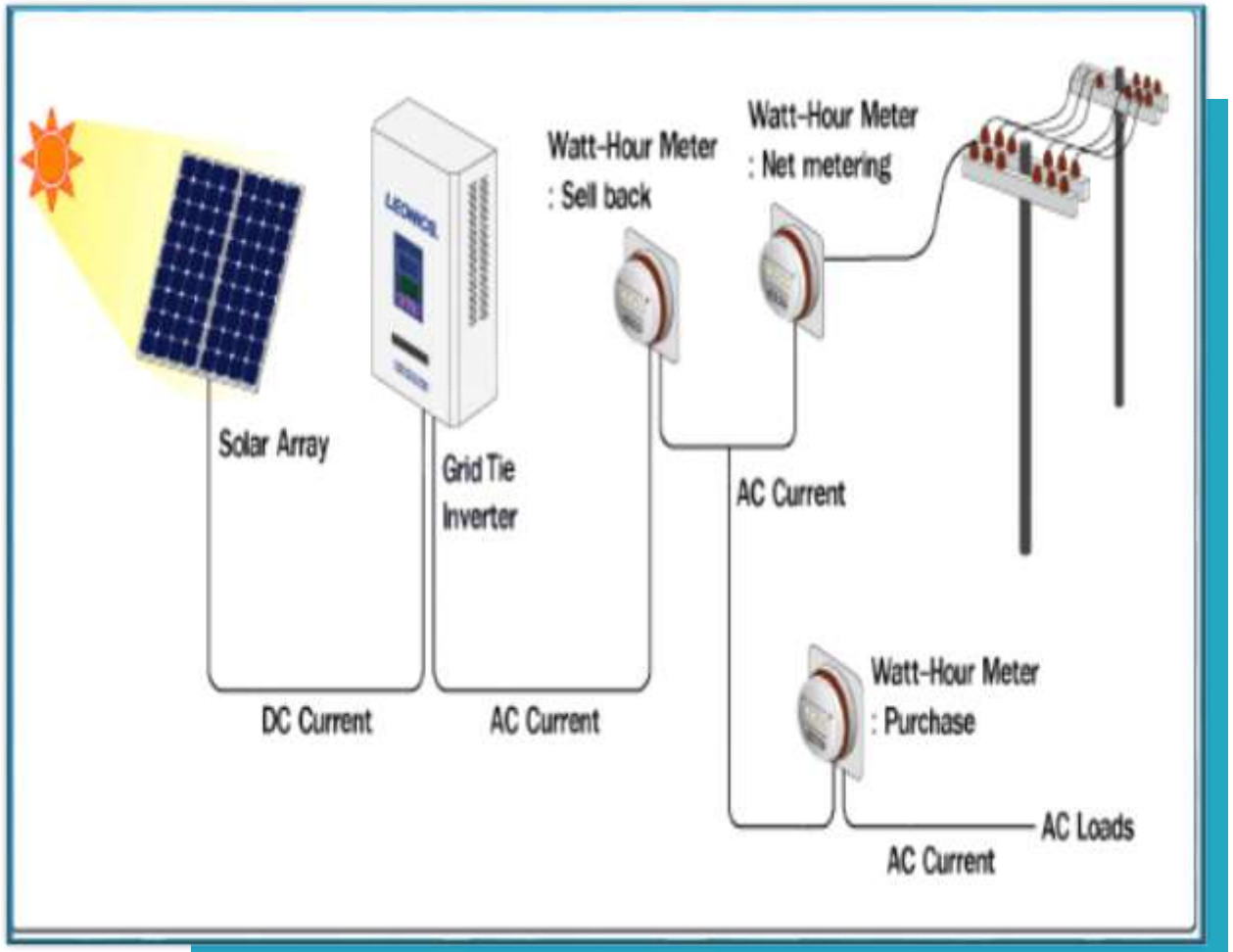

On Grid Systems

1

On-grid means solar system is tied to local utility company’s system.

2

They are connected to the grid through iinverters, and do not require batteries

3

These systems can also feed power back into the grid during times of low usage and high production.

4

Being grid-tied is beneficial because we don’t have to buy an expensive battery back-up system to store any excess energy.

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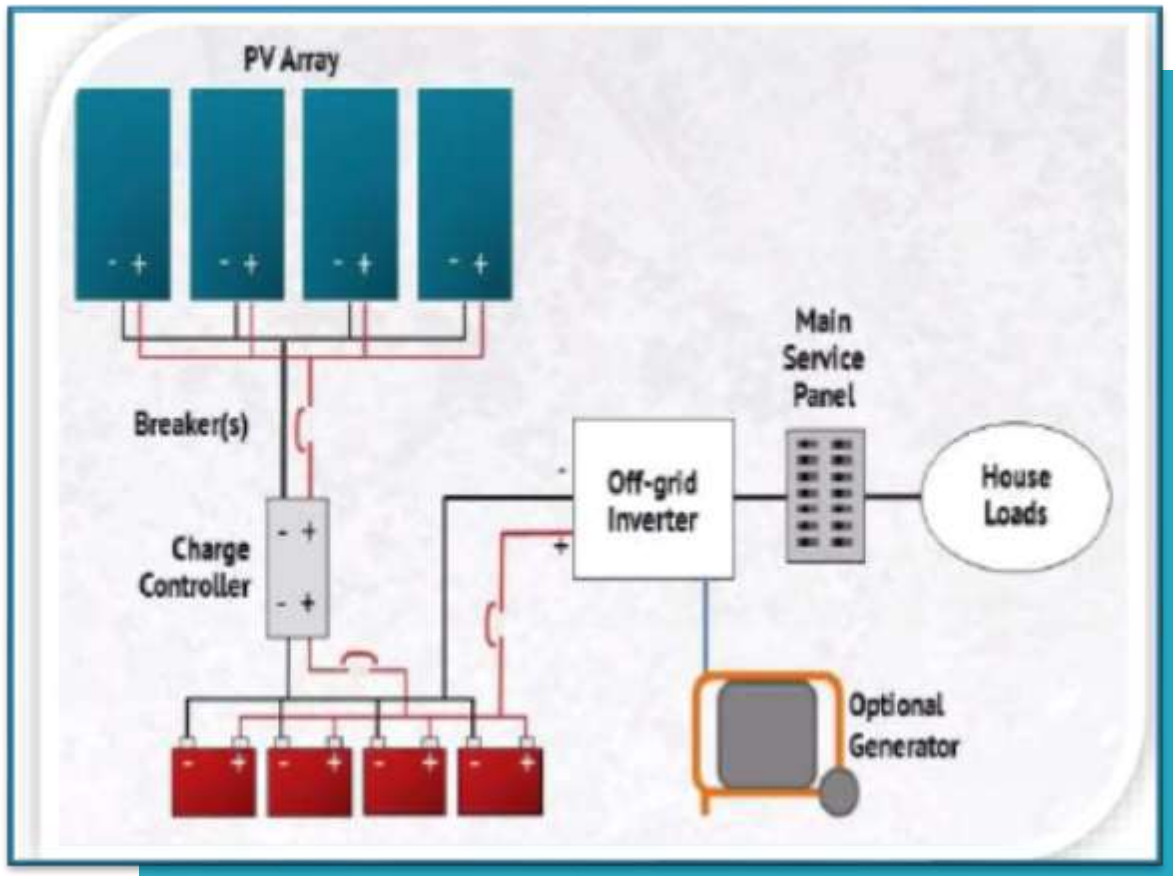

Off Grid Systems

1

Stand-alone systems rely on PV power only. These systems can comprise only PV modules and a load or can include batteries for energy storage.

2

When using batteries charge regulators are included, which switch off the PV modules when batteries are fully charged, and switch off the load in case batteries become discharged below a limit.

3

The batteries must have enough capacity to store the energy produced during the day to be used at night and during periods of poor weather.

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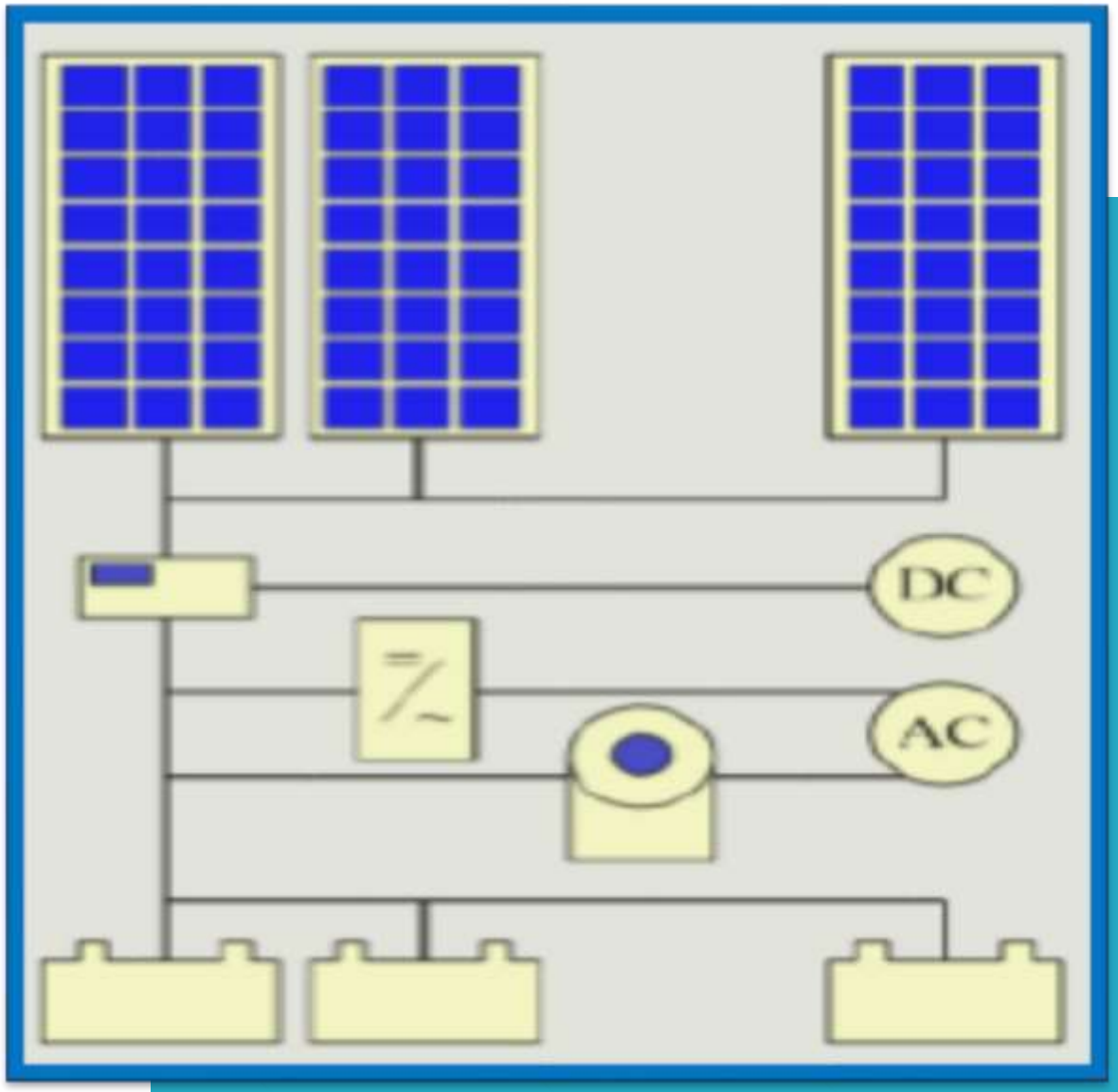

HYBRID SYSTEMS

1

Hybrid systems consist of combination of PV modules and a complementary means of electricity generation such as a diesel, gas or wind generator

2

A common problem with hybrid PV/diesel generators is inadequate control of the diesel generator.

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TRANSPARENT SOLAR MODULES

Transparent solar modules consist of transparent crystalline cells, very often are also modules with transparent back side and with standard crystalline cells.

Different types of transparent modules are used as glazing, most common crystalline as single glazing or double (low U-value) insulation glass. Transparent modules can also be used in sunspaces and atriums.

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Solar Energy Calculated

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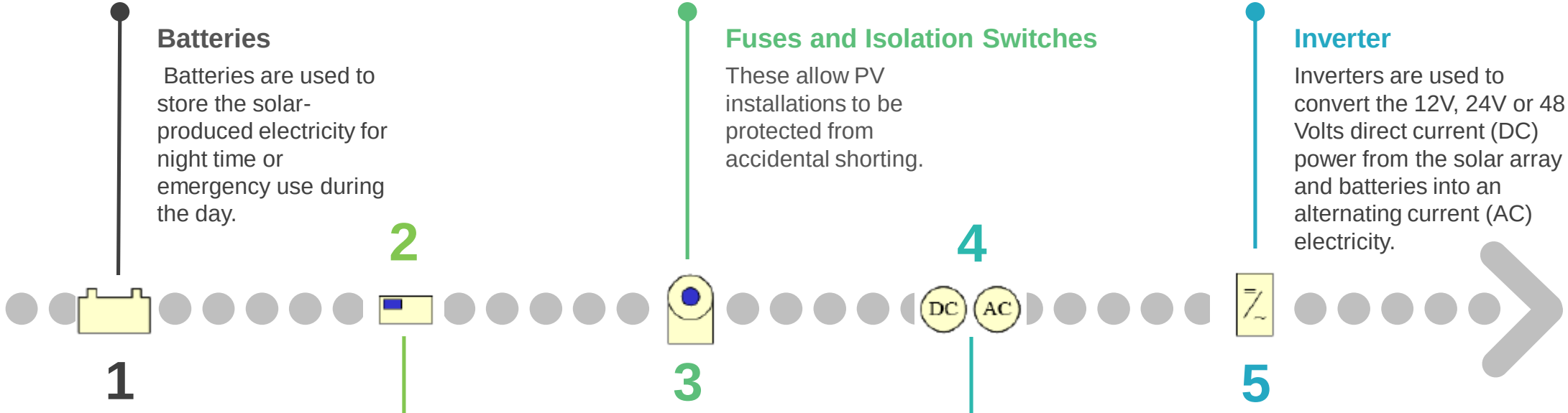
Simplified Off Grid PV System



Batteries

Batteries are used to store the solar-produced electricity for night time or emergency use during the day.

Charge Controllerr

A charge controller regulates and controls the output from the solar array to prevent the batteries from being over charged (or over discharged) by dissipating the excess power into a load resistance.

Fuses and Isolation Switches

These allow PV installations to be protected from accidental shorting.

Wiring

The final component required in and PV solar system is the electrical wiring.

Inverter

Inverters are used to convert the 12V, 24V or 48 Volts direct current (DC) power from the solar array and batteries into an alternating current (AC) electricity.

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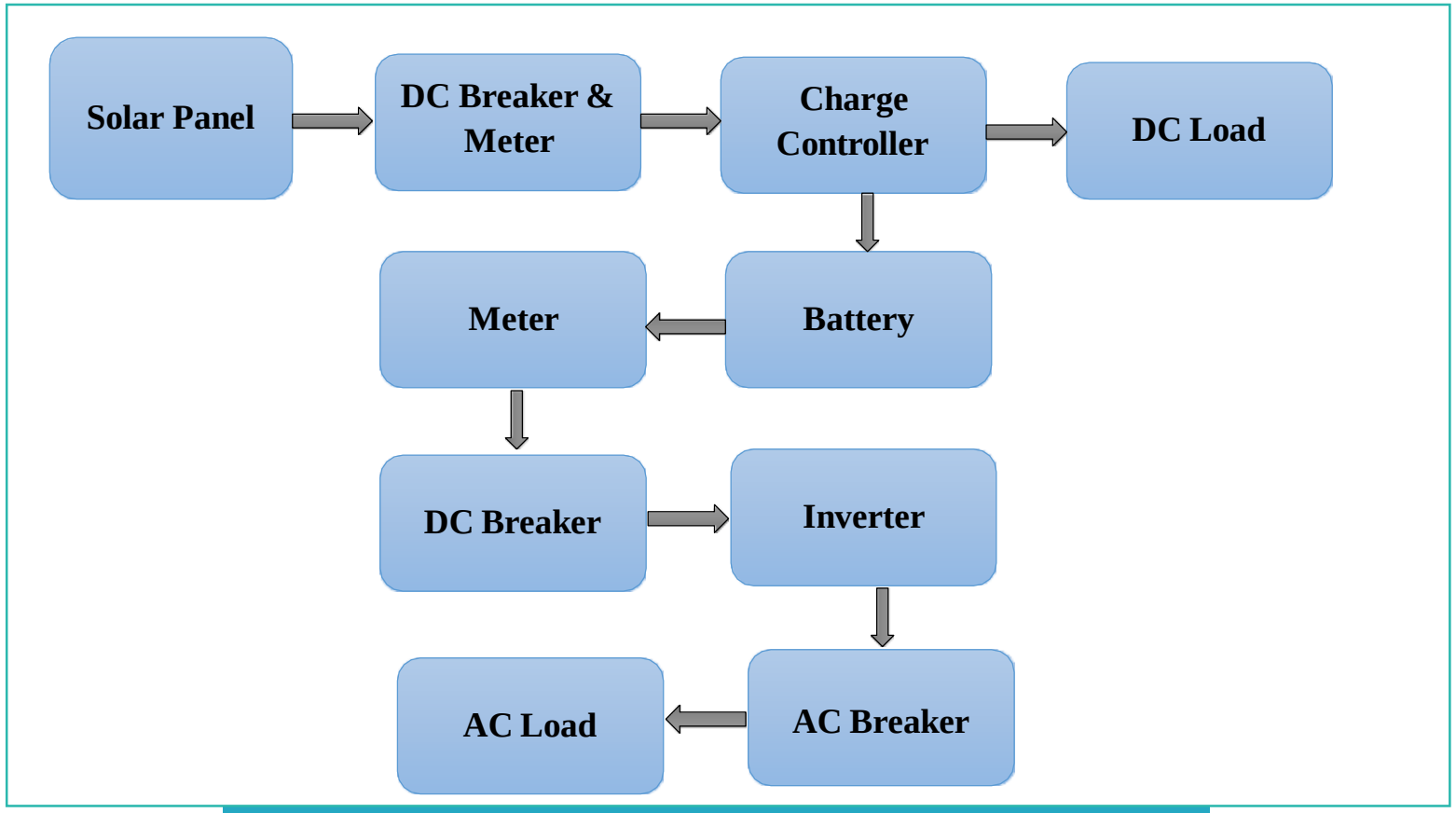

Off Grid Systems

For an off-grid solar system we need four basic components:-

1. Solar Panel (PV Panel)
2. Charge Controller
3. Inverter
4. Battery

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Types of Loads

01

Basic Loads

Lamp, LED Tv, charge contoller

02

Large appliances

Refrigator, washing machine, vacumm cleaner.

03

Special Loads

Air conditioner, electric heater.

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Step 1: Calculate total DC loads

Store / Calculators

www.altestore.com/store/calculators/load_calculator

LOAD CALCULATORS

+1 +17 Recommend this on Google

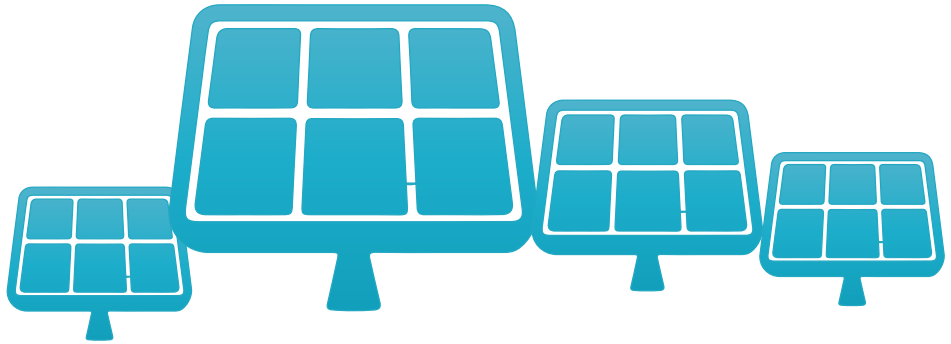
Fill in your appliances & loads here or use our default values in the 'Help!' section below.

Appliance/Load Name	On at Same Time*	Quantity	AC Watts	AC Surge*	DC Watts*	Hours On per Day	Watt-Hours / Day
Lights	✓	4	13	13	0	5	260
DC Lights		2	0		11	2	44
Stereo	✓	1	30	30	0	2	60
1/5HP well pump	✓	1	375	1500	0	5	187.5
Table saw	✓	1	1400	4200	0	4	560
Fridge	✓	1	120	1100	0	9	1080

Add load

Total Watt-Hours/Day: 2191.5

*Values only needed if you want a system which operates with batteries (e.g. an off-grid solar system)



Step A: Determine average daily DC load in watt- hours

AC average daily load (Wh/day)	Inverter eff.	DC average daily load Wh/day	Average daily DC load Wh/day
2000	/0.92	+100	= 2273

How to convert AC loads to DC loads.

DC loads= AC Loads/Inverter efficiency

$$L_{eff} = \frac{Total\ DC\ loads}{Battery\ Voltage}$$

$$L_{eff} = \frac{2273}{24} = 95,055\ Ah/day$$

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Step 2: Size of Battery Bank

Days of Autonomy: The amount of time (days) the system can operate on battery power alone with no input from other generation sources (PV, and generator).

DoD (Depth of discharge): Measure of maximum capacity to be withdrawn from a battery

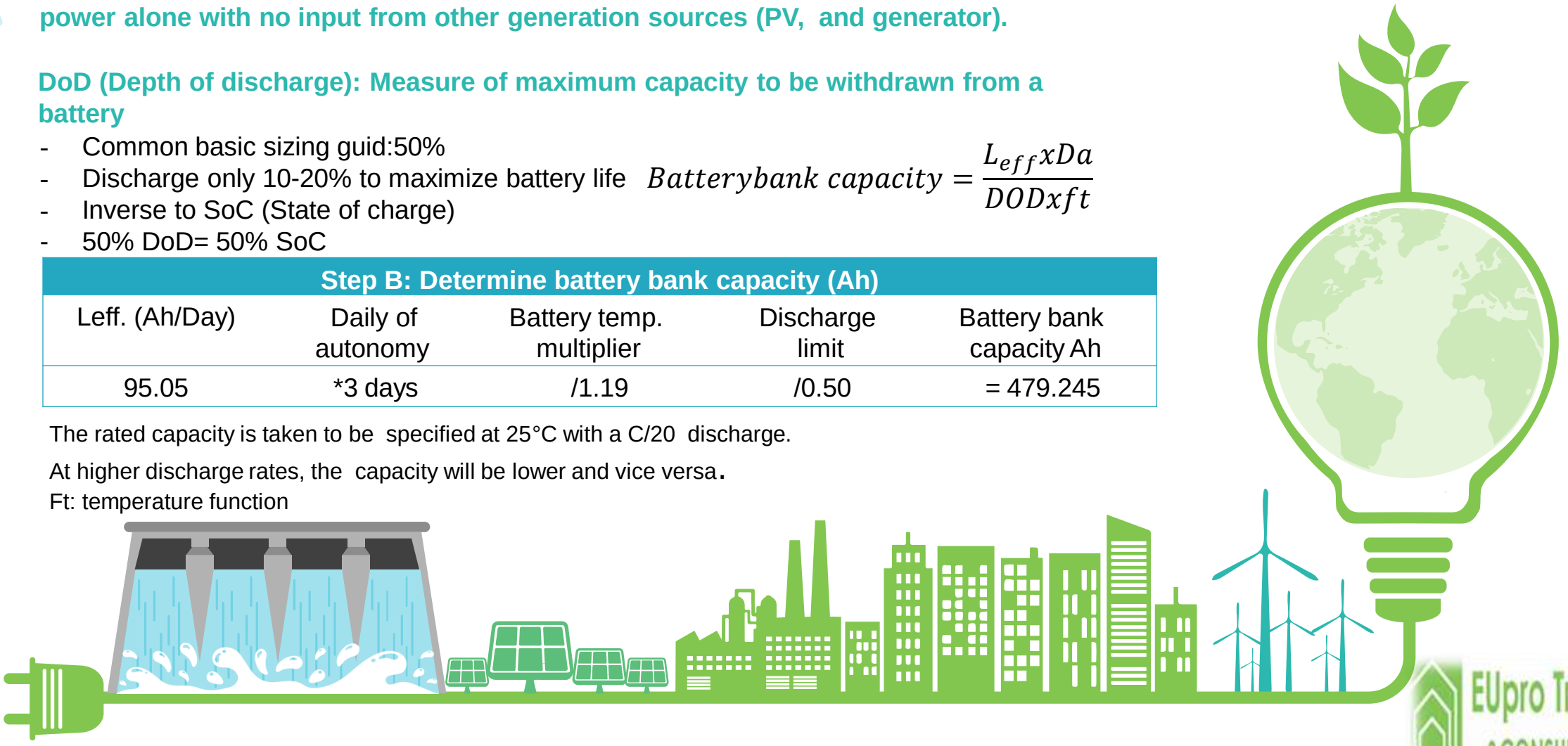
- Common basic sizing guid:50%
- Discharge only 10-20% to maximize battery life $Batterybank\ capacity = \frac{L_{eff} x Da}{DODxft}$
- Inverse to SoC (State of charge)
- 50% DoD= 50% SoC

Step B: Determine battery bank capacity (Ah)				
Leff. (Ah/Day)	Daily of autonomy	Battery temp. multiplier	Discharge limit	Battery bank capacity Ah
95.05	*3 days	/1.19	/0.50	= 479.245

The rated capacity is taken to be specified at 25°C with a C/20 discharge.

At higher discharge rates, the capacity will be lower and vice versa.

Ft: temperature function



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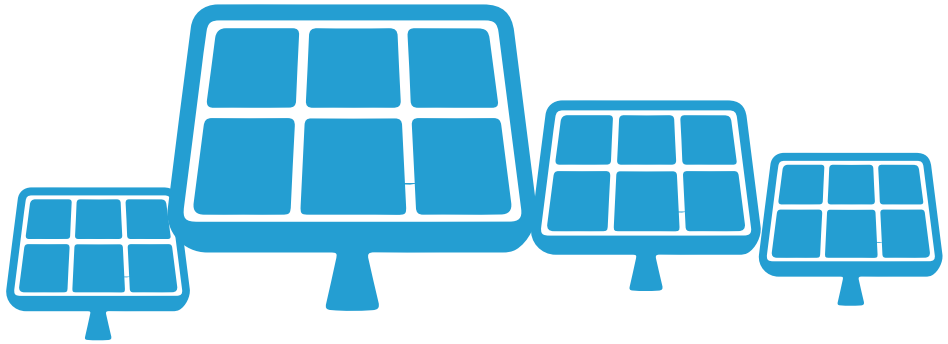
Step 3: Solar Panel Selection

- Solar panels are generally rated under standard test conditions (STC): **irradiance of 1,000 W/m², solar spectrum of AM 1.5 and module temperature at 25°C.**
- During the 12hr day time the sunlight is not uniform, and it also differ according to our location on the globe.
- So we can assume **5 hours of effective sunlight** which will generate the rated power.
- So total power output of Panels = 24V * 479.245 Ah = 11 kWh
- Power to be generated per hour = 11000 / 5= 2.2 kW



PV Panels

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Step 4: Charge Controller Selection

A solar charge controller is a device which is placed between a solar panel and a battery.
It regulates the voltage and current coming from solar panels.
It is used to maintain the proper charging voltage on the batteries.
As the input voltage from the solar panel rises, the charge controller regulates the charge to the batteries preventing any over charging.

Rating of Charge Controller:

- Since our system is rated at 24 V, the charge controller is also 24 V.
- Current rating = Power output of Panels / Voltage = 2200 W / 24V = 91.67 A
- So choose a Charge Controller of 24 V and more than 91.67 A.

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Step 5: Inverter Selection

Inverter Types

1. Square Wave
2. Modified Sine Wave
3. Pure Sine Wave (SPWM)

- **Square wave** inverters are the cheapest but not suitable for all appliances.
- **Modified Sine Wave** output is also not suitable for certain appliances, particularly those with capacitive and electromagnetic devices such as: a fridge, microwave oven and most kinds of motors.
- Typically modified sine wave inverters work at lower efficiency than pure sine wave inverters.
- Mostly SPWM type inverter use in off grid solar system.

1

The power rating should be equal or more than the total load in watt at any instant.

2

In our case the maximum load at any instant = A.C. (630 W)+ Refrigerator (530 W) + T.V. (200W) + Fan (6*80W) + CFL (6*11W) = 2000 W
By taking some margin we can choose a 2000 W inverter.

3

As our system is 24 V we have to select a 24V DC to 230V/50Hz AC pure sine wave inverter.

Step 6: Mounting the Solar Panel

- After designing the solar system, buy appropriate all the components with rating as per the previous steps.
- Now it is time to mount the solar panel. First choose a suitable location on the roof top, or on the ground, where there is no obstruction of sunlight.
- The tilt of the stand is nearly equal to the latitude angle of our location.
- **Tilting** : To get the most from solar panels, we need to point them in the direction that captures the maximum sun light, i.e. south if we are in the northern hemisphere or north if we are in the southern hemisphere.

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Metering and Data logging

- We are interested to know how much energy is produced by our solar panel or how much energy being consumed by our appliances we have to use energy meters.
- the meter combines accurate 1-phase and 3-phase energy and power measurements with data logging, power quality analysis, alarming and I/O capabilities are typically available in such a compact meter.
- It provides a high degree of visibility to data and assets that allows for cost savings, rapid response time, and better decisions.
- Improve operations and profitability of our facility with this easy-to-install, easy-to-operate meter.

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Types of PV Panels

Monocrystalline

The most efficient solar panel is monocrystalline. This type of solar panel produces large energy in a small area.
the price of more expensive than other solar panels.
their efficiency is about 24%
It can be almost twice as much as other energy panels.
These solar panels have a longer usage and electricity production life.
In case of more or less shading, the entire solar panel may be negatively affected.

Polycrystalline

It is the cheapest solar panel.
Almost more than 68% of the market uses polycrystalline solar cells.
efficiency rates are around 15%
It takes up more space and produces less energy.

Thin Film Solar Panel

It is the lightest and easiest panel to mount.
It has the smallest share in the market.
It takes up too much space.
It is approximate efficiency is around 7%.
We can say that it is more preferred for design.

Flexible Solar Panel

It is a solar panel with many usage possibilities.
It is unbreakable and very durable.
It is very light.
Its structure can be both monocrystalline and polycrystalline. In this case, this also diversifies the efficiency of energy panels.

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It is 40-50 times more efficient than solar panels on the market. It is an incredible electricity production efficiency in a very small area.
It is sprayed on any glass surface and the glass surface is completely covered with this liquid. Then the coated glass surface begins to generate electricity.In addition, it is almost not affected by shadowing situations.

Transparent Solar Panel

Global Solar Generator

Actually, this is not a solar panel. But it is a good method for generating electricity from solar energy. Thanks to a sphere filled with water, maximum efficiency can be obtained from light

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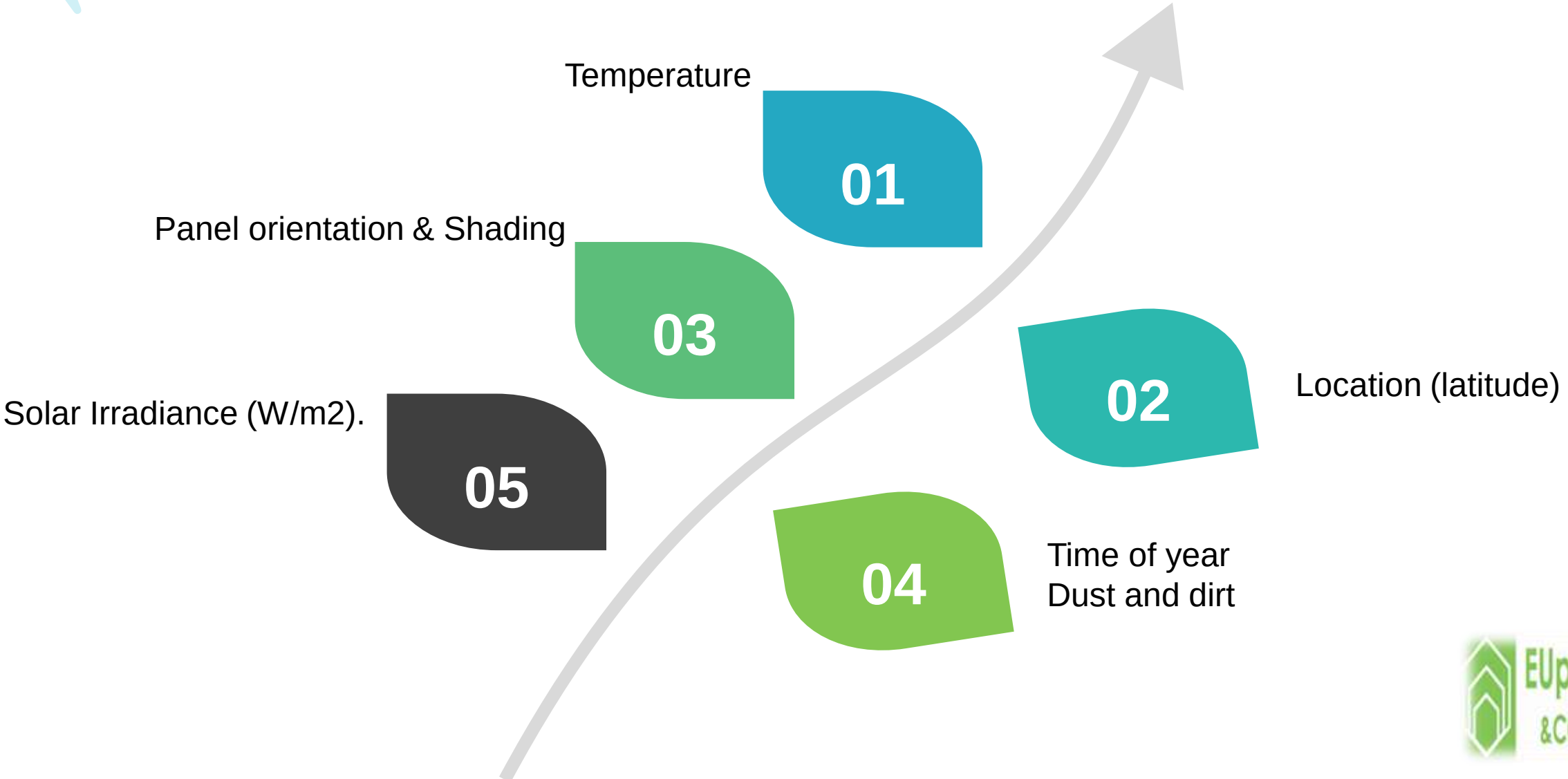
The Factors of Panel Efficiency



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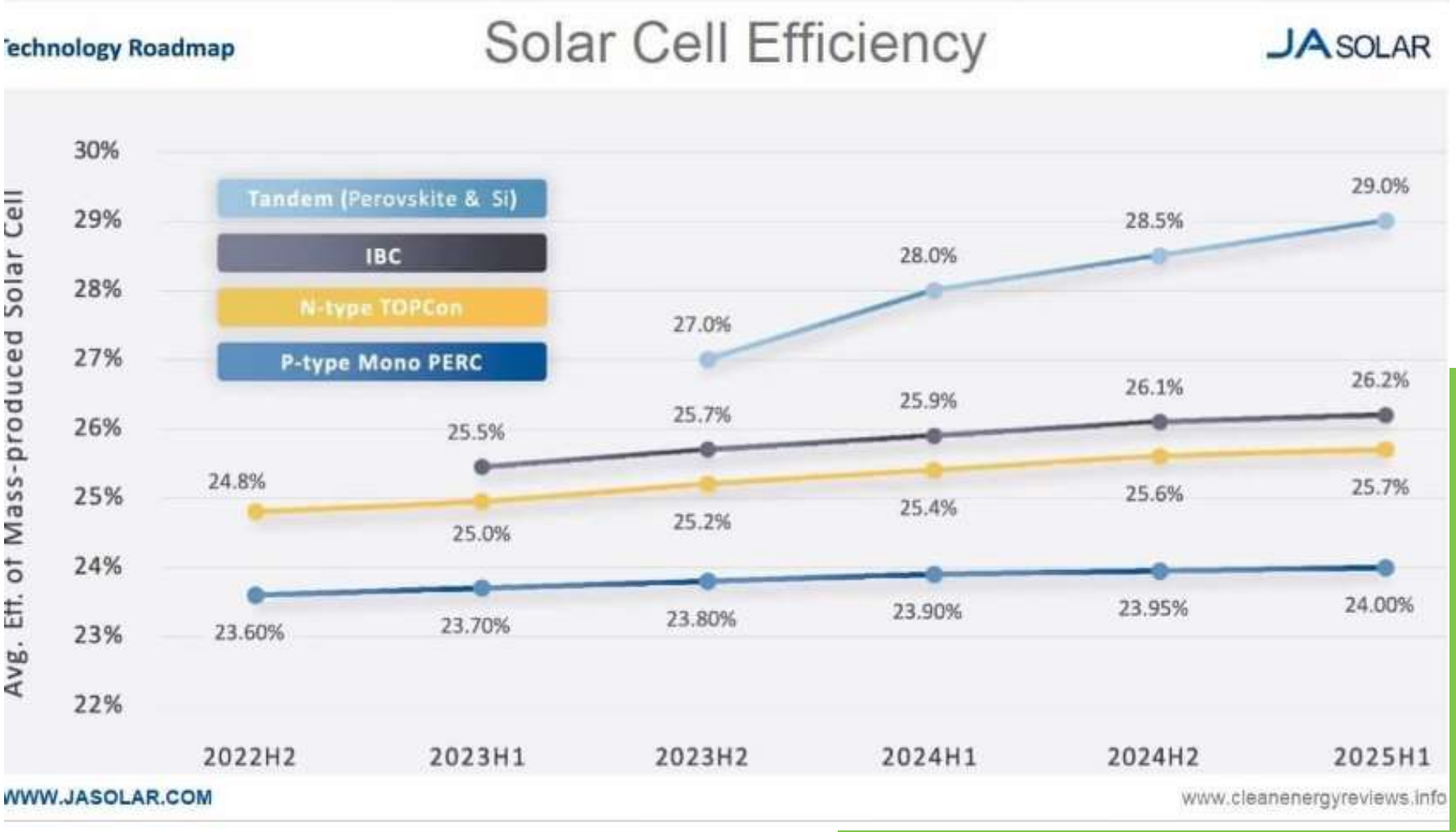
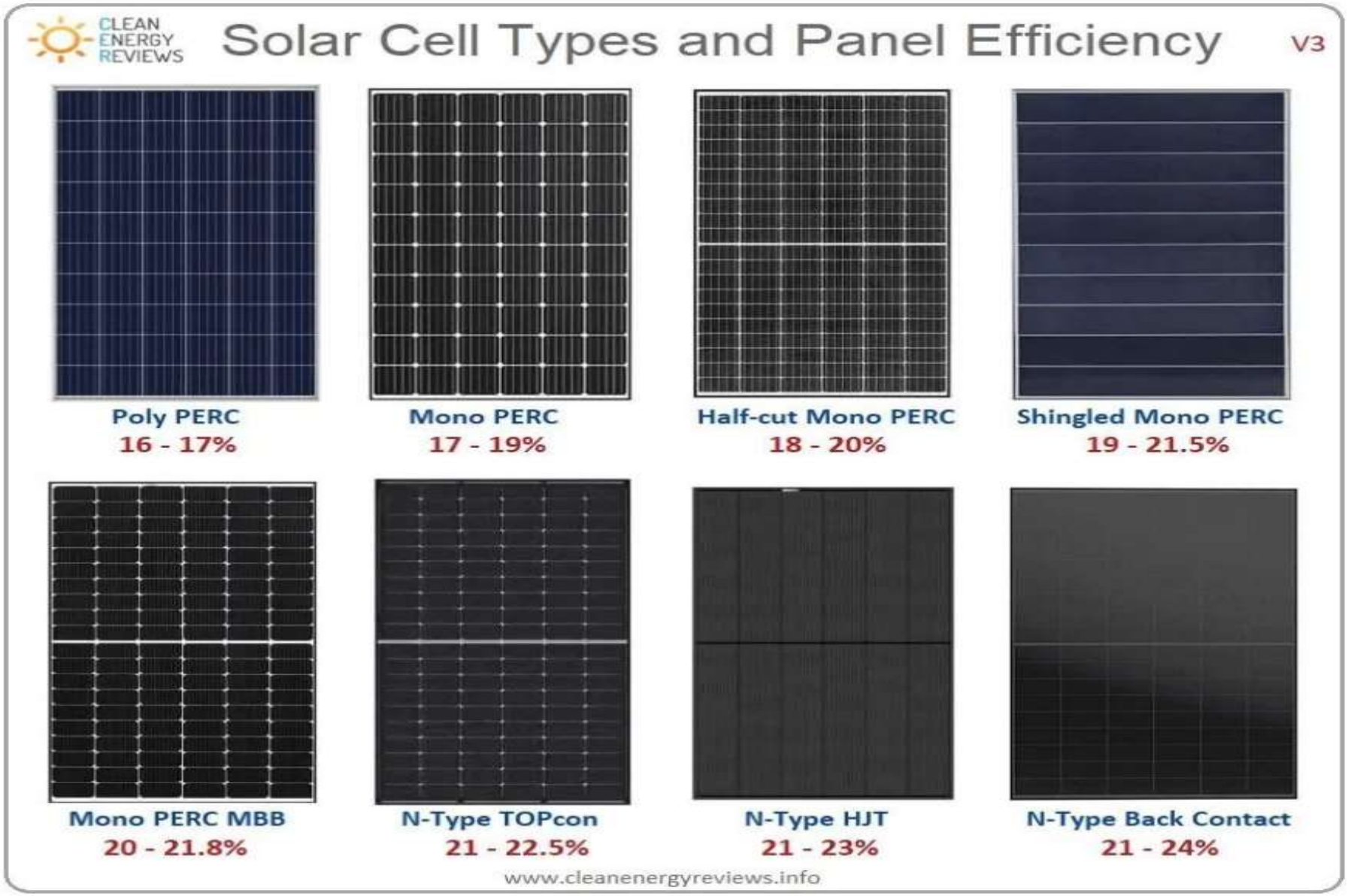


Solar panel efficiency is measured under **standard test conditions** (STC)
Based on a cell temperature of 25 ℃, solar irradiance of 1000W/m2 and of 1.5.
A solar panel's efficiency (%) is calculated by dividing the module power rating (W), or Pmax, by the total panel area in square meters at an irradiance level of 1000W/m2 (STC).

Panel Efficiency



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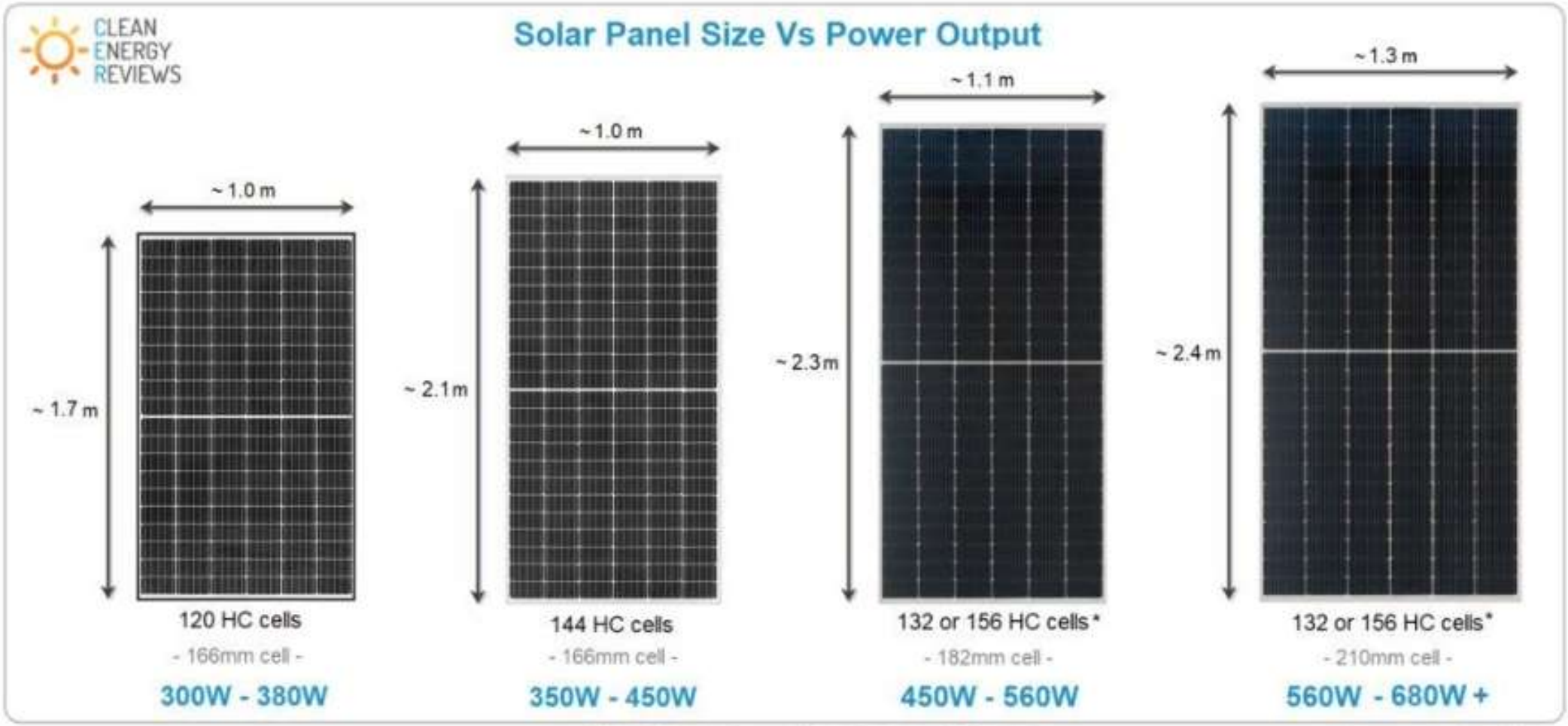
Types of Panel Efficiency

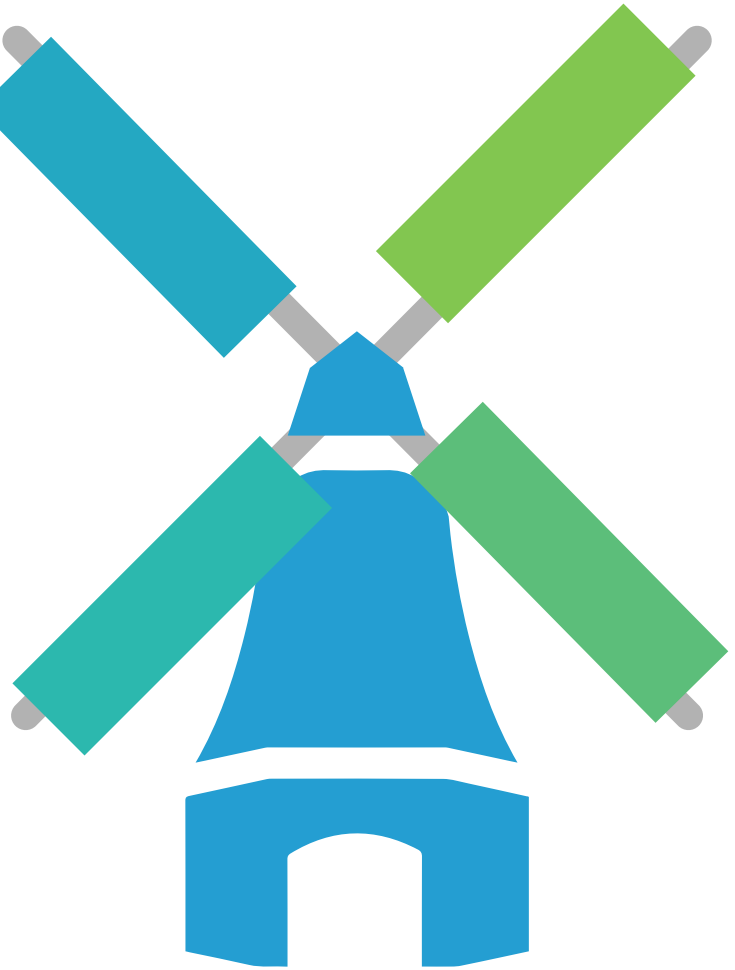


Panel Size & Power Output

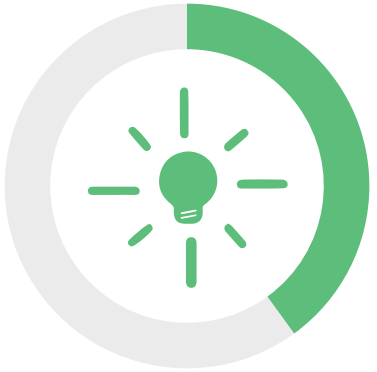
Wind Energy

Wind Turbine

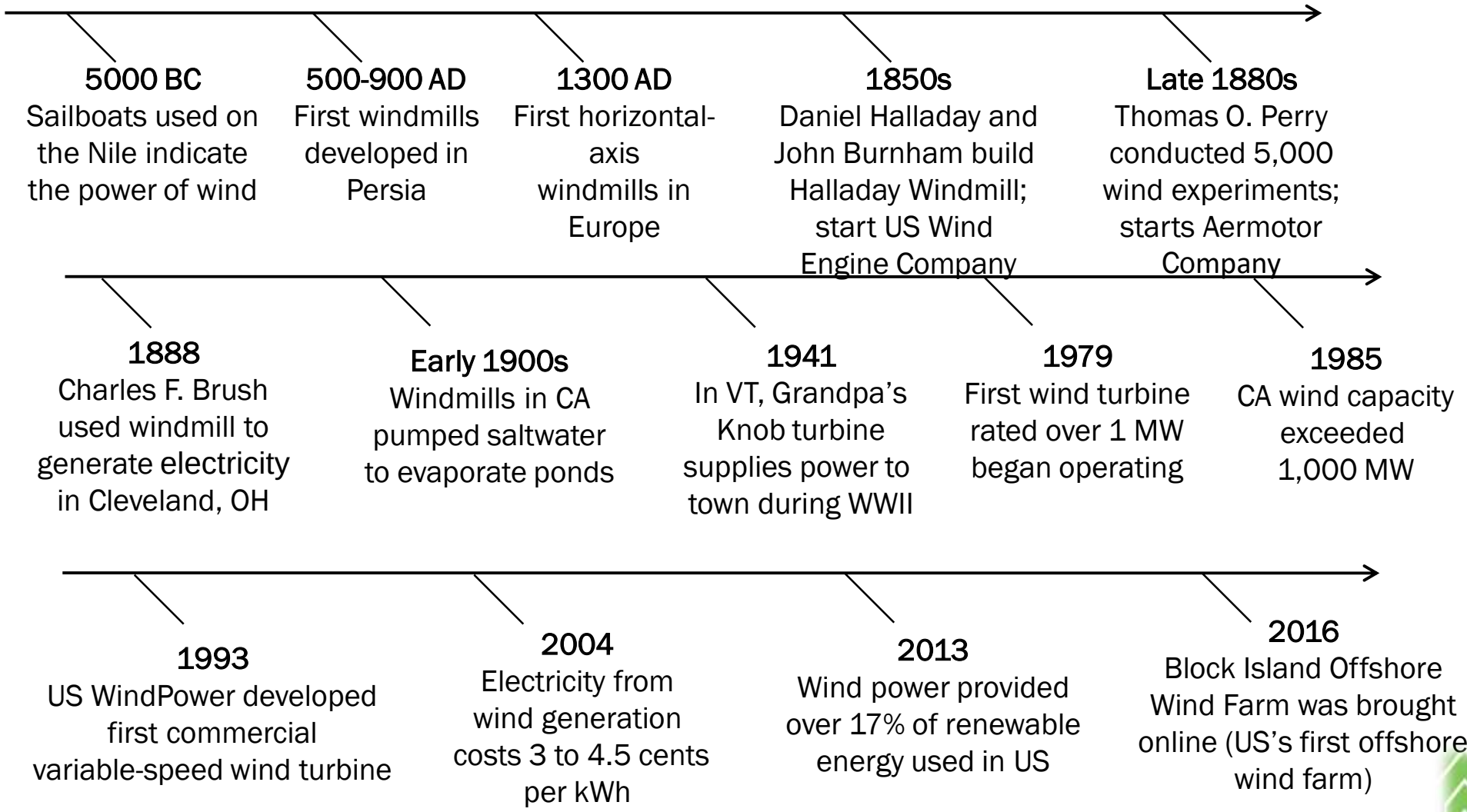
Wind turbine is a type of turbine that converts wind energy into mechanical energy. Wind energy results from the energy of motion of the wind, called kinetic energy.



Wind turbines generally come in various sizes and types. While smaller turbines can be used on homes or farms, larger turbines are often used in large-scale wind farms or offshore wind farms..



History of Wind Energy



Components of a wind turbine

- TOWER: Supports the weight of turbine mechanism and absorbs loads put on the turbine by external forces
- NACELLE: Attached to tower, rotates towards wind to maximize rotor speed, houses generator assembly
- BLADES: Blade design generally uses lift, the creation of a high and low pressure zone from the wind to move the blades.
- ROTOR: Holds blades, rotates in order to turn generator to produce power

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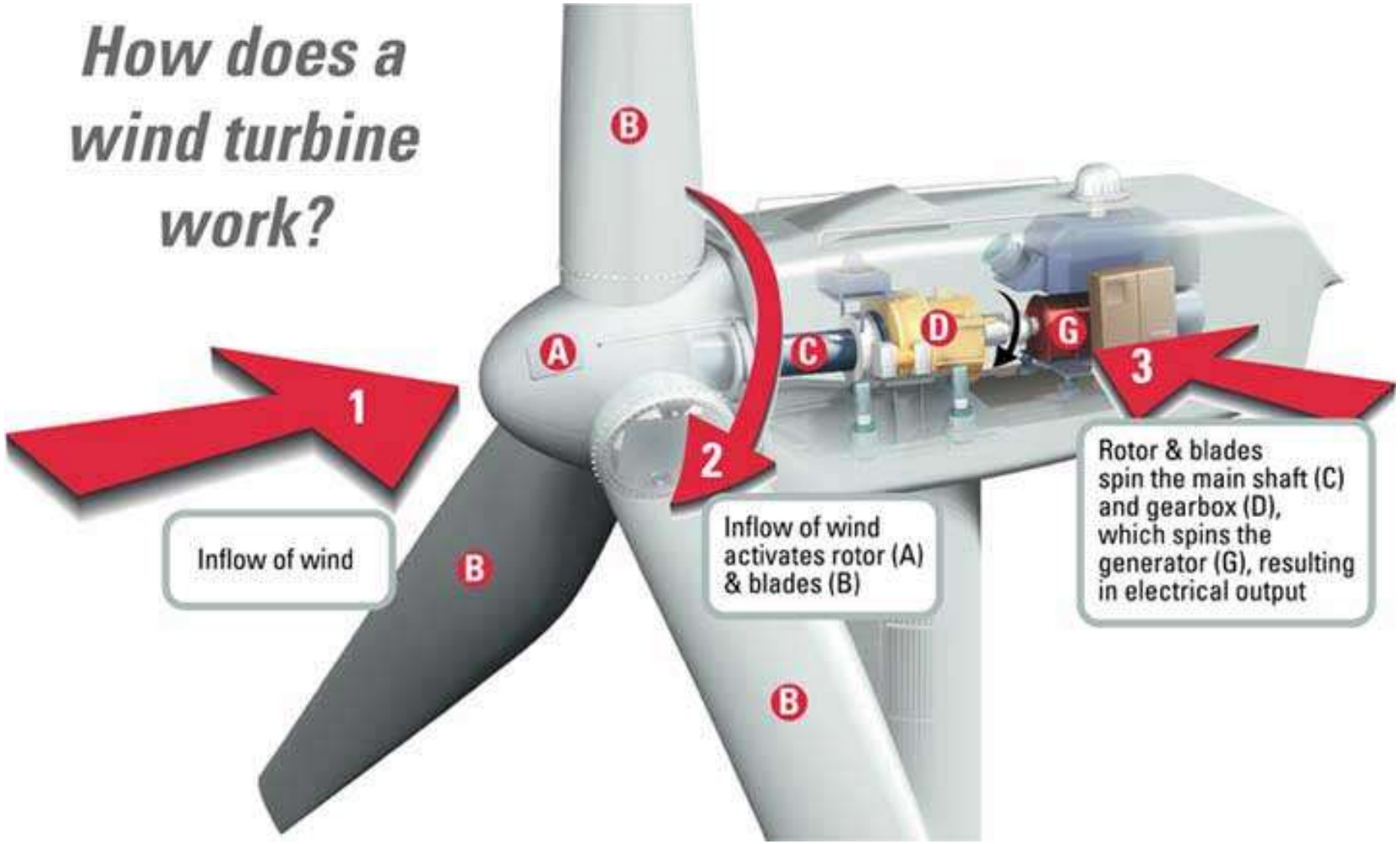
How a Wind Turbine Operates



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Turbines can be categorized into two classes based on the orientation of the rotor.

Vertical-Axis Turbines

Horizantal-Axis Turbines

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Small (<10 kW)

- Homes
- Farms
- Remote Applications (e.g., water pumping, Telecom sites, ice making)

Intermediate (10-250 kW)

- Village Power
- Hybrid Systems
- Distributed Power

Large (250 kW-2+ MW)

- Central Station Wind Farms
- Distributed Power
- Schools

.

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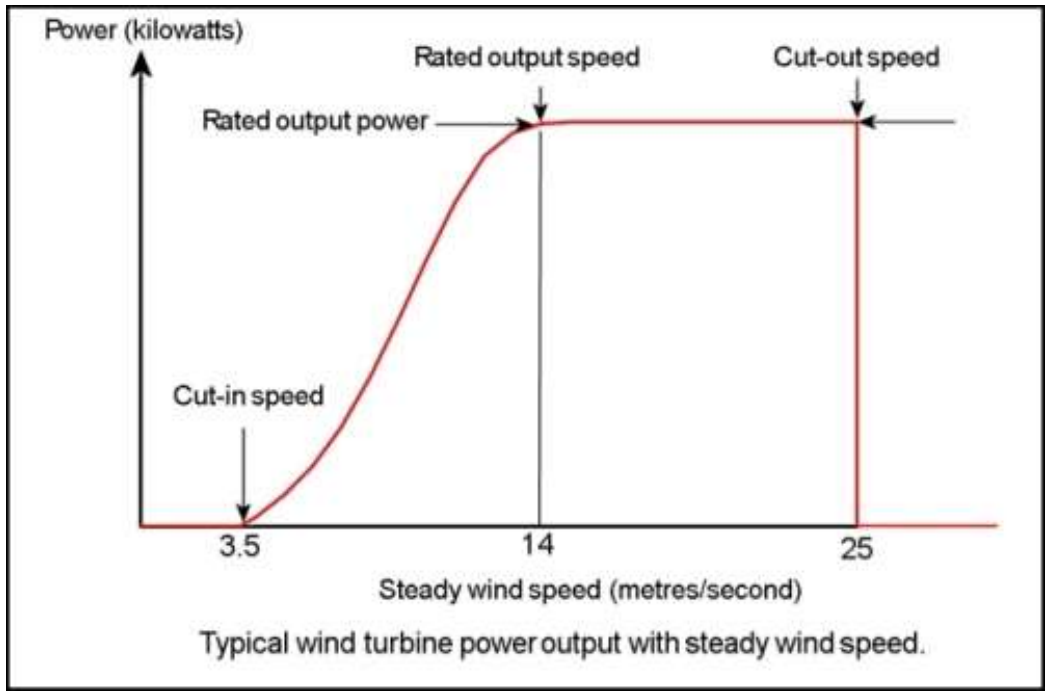
What is the wind vs power output?

- The maximum conditions for most windmills are around 35-55 mph (14-25 m/s).
- Slower speeds decrease the power output drastically.
- For example, if the wind speed decreases by half then the power output decreases by a factor of 8.
- Obviously every windmill has a different power output at different wind speeds, but most follow the trend shown below.



Typical wind turbine power output with steady wind speed.

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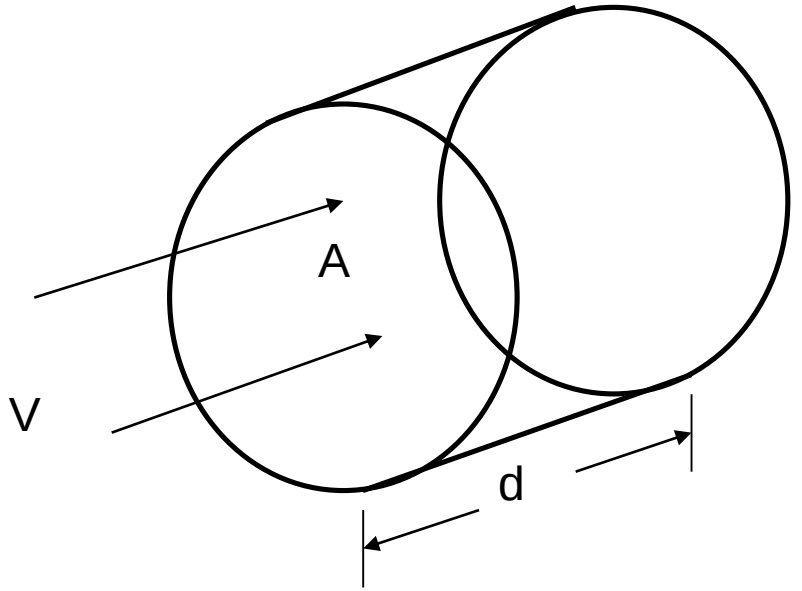
How much Power does a Wind Turbine Generate?

Kinetic Energy = Work = $\frac{1}{2}mV^2$

Where:
M= mass of moving object
V = velocity of moving object

What is the mass of moving air?

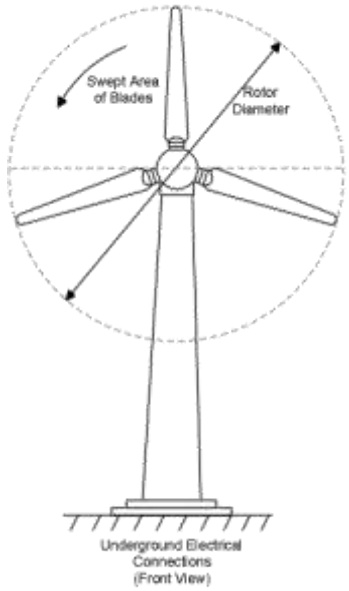
= density (ρ) x volume (Area x distance)
= ρ x A x d
= (kg/m^3) (m^2) (m)
= kg



How much Power does a Wind Turbine Generate?

Power = Work / t =Kinetic Energy / t= ½mV^2 / t= ½(ρAd)V^2/t= = ½ρAV^3

Power in the Wind =½ρAV^3



Swept Area – A = πR2 (m2)

Area of the circle swept by the rotor.

ρ = air density –its about ***1-kg/m3***

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Calculating Power in the Wind

V = 5 meters (m) per second (s)

m/s

ρ = 1.0 kg/m^3

R = .2 m >>>> A = .125 m^2

Power in the Wind = ½ρAV^3

= (.5)(1.0)(.125)(5)^3

= 7.85 Watts

Power from a Wind Turbine Rotor = C_p½ρAV^3

- C_p is called the ***power coefficient***.
- C_p is the percentage of power in the wind that is converted into mechanical energy.

What is the maximum amount of energy that can be extracted from the wind?

Betz Limit: $C_{p,\max} = \frac{16}{27} = .5926$

What's the most power the .2-m turbine in the example can produce in a 5 m/s wind?

7.85 Watts x .5926 (Betz Limit) = 4.65 Watts

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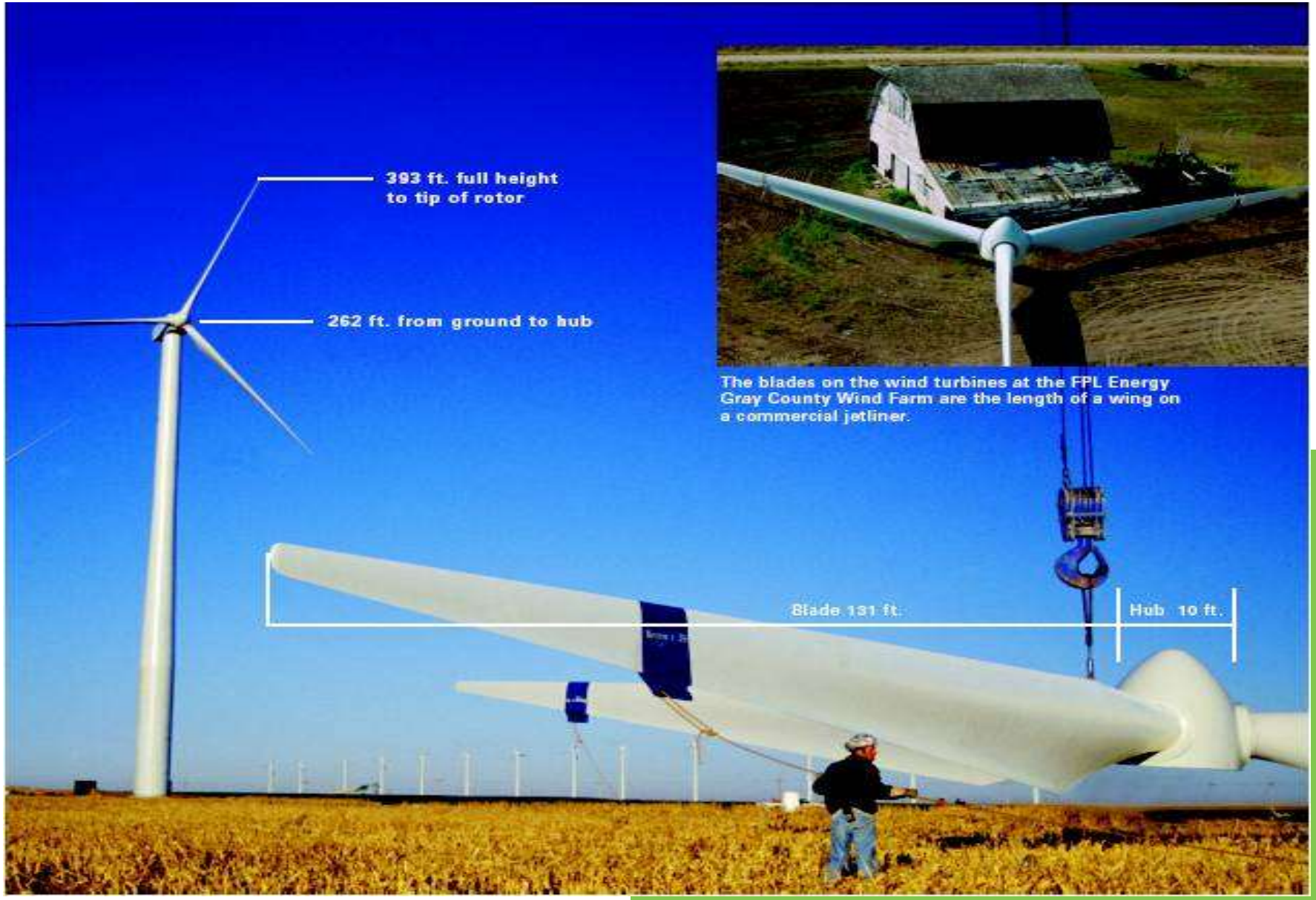
Installation of Wind Turbines



The blades on the wind turbines at the FPL Energy Gray County Wind Farm are the length of a wing on a commercial jetliner.

Wind Turbine Perspective

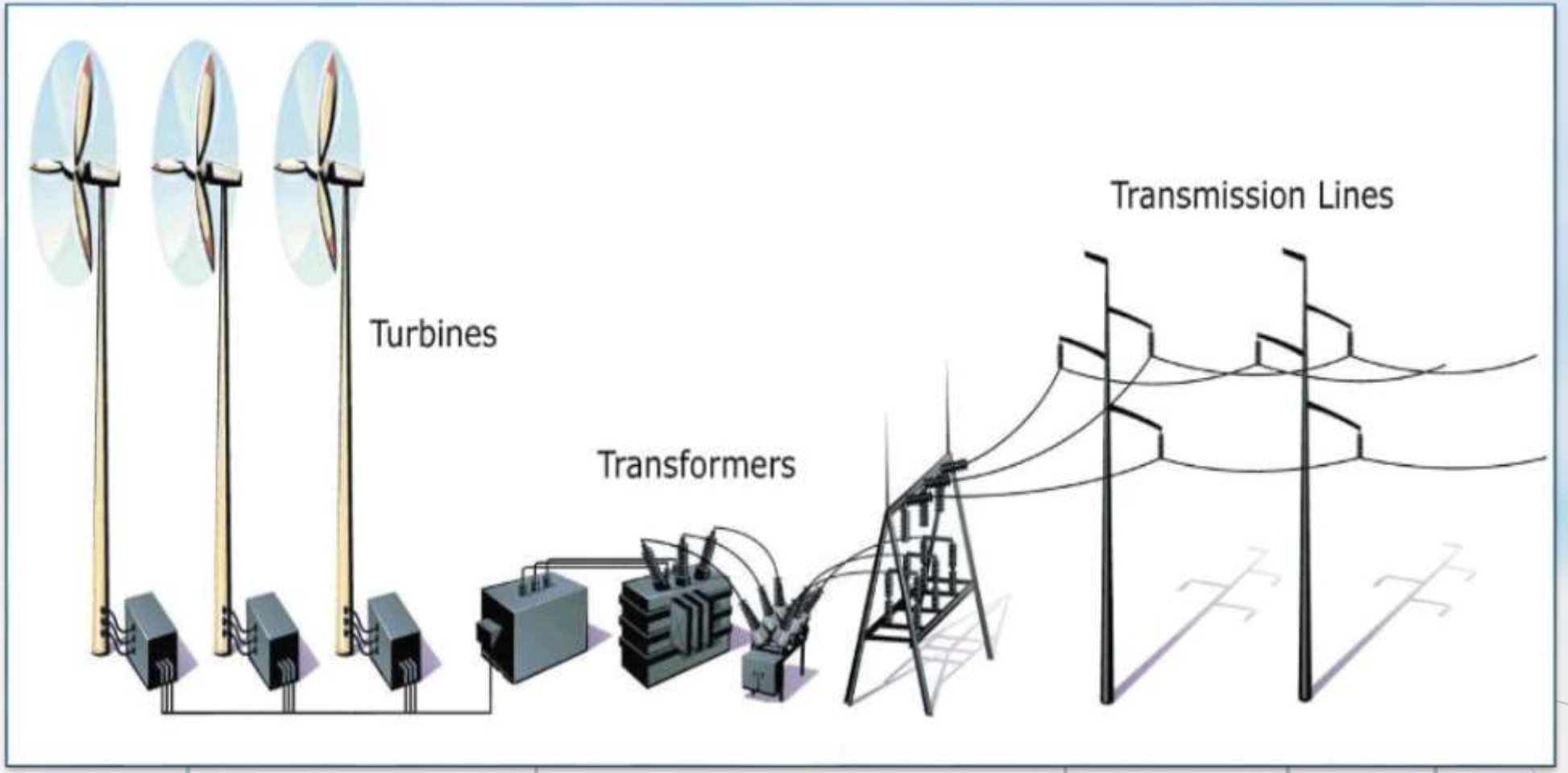
Workers

Blade
112’ long

Nacelle
56 tons

Tower
3 sections

Wind Farms



The first U.S. offshore wind farm is Block Island Wind Farm, located off the coast of Rhode Island. This five-turbine, 30 megawatt wind farm began operation in 2016.

Advantages

- As long as there is sun, there will be wind it will be a continuous source.
- It is a renewable and clean energy source. Pollution-free, environmentally friendly wind energy can produce electricity without producing almost any carbon dioxide
- It is environmentally friendly.
- Its cost has reached a level competitive with today's conventional power plants.
- Maintenance and repair costs are low
- Wind is completely domestic and does not create import dependency like oil and its derivatives
- Its technology is relatively simple to install and operate.
- Can be commissioned and operated in a short time

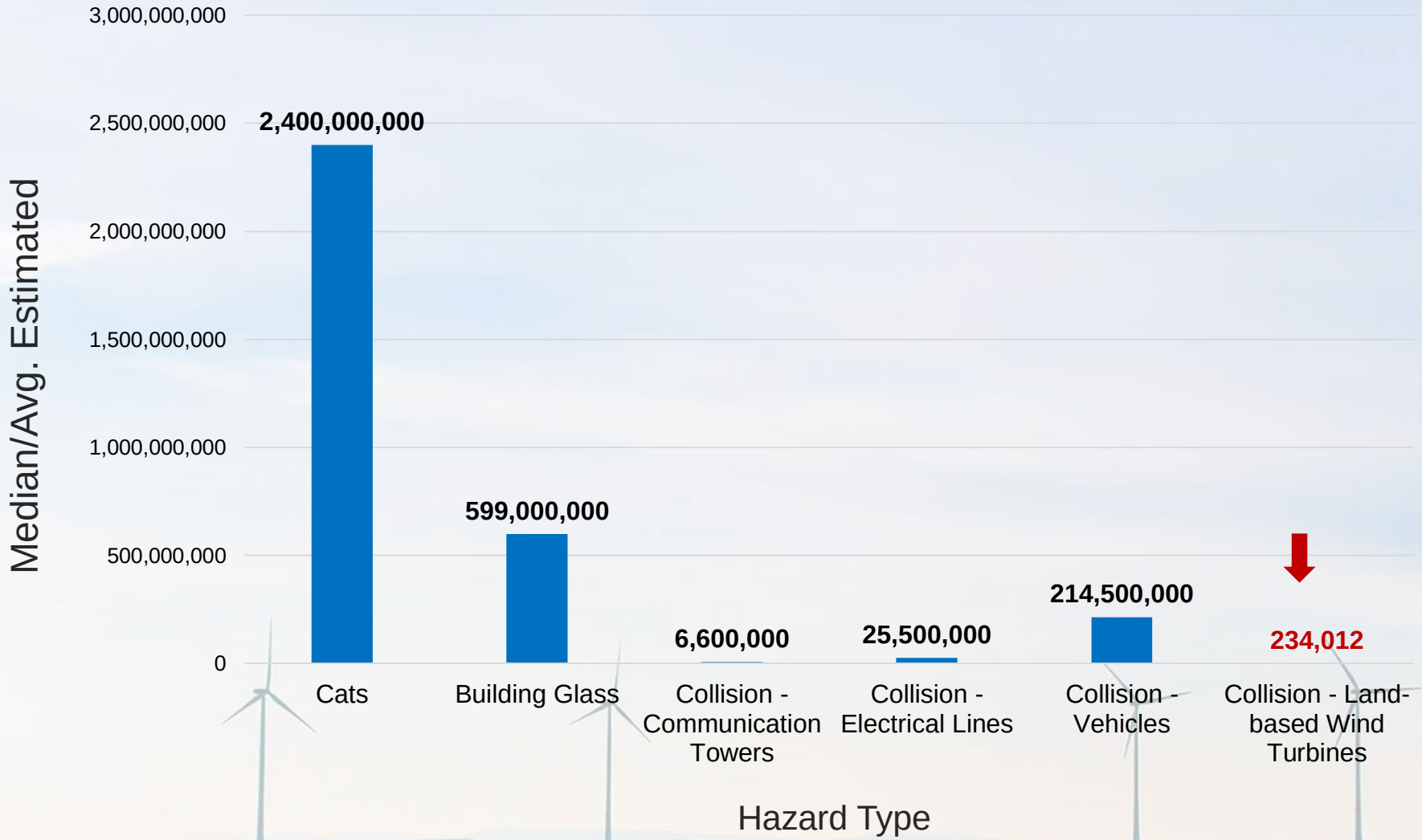
Disadvantages

- Wildlife: Wind turbines can be dangerous to flying animals.
- Remoteness of the location: While this can be an. Travel and maintenance of turbines increases in cost and takes time. Offshore wind turbines require boats and can be dangerous to manage
- Noise: Some wind turbines tend to produce a lot of noise, which can be unpleasant.
- Safety at Sea: Wind turbines can be difficult for boats traveling at night to see, which can lead to collisions

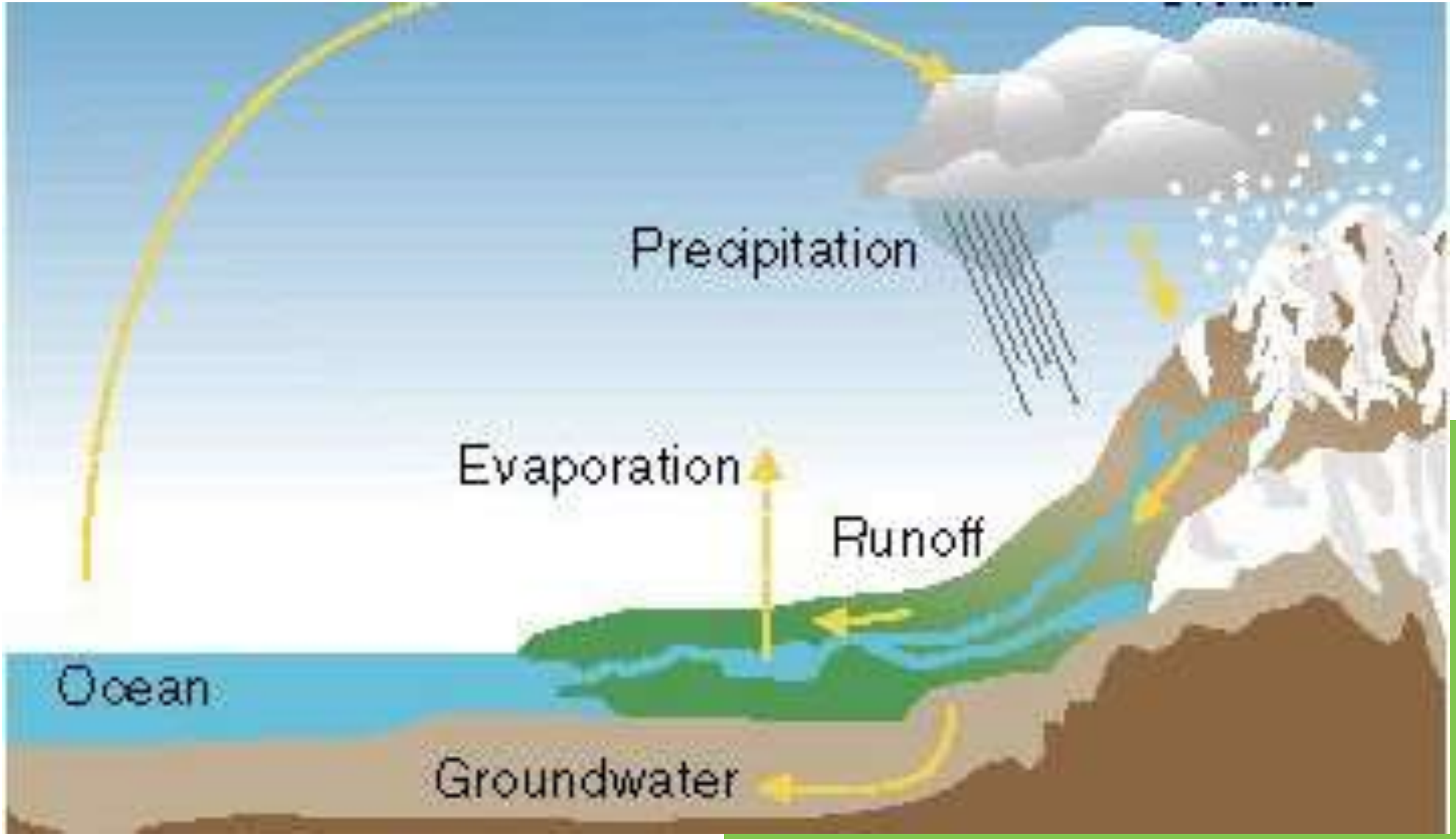
Cost vs Benefit

- On average, windmills produce $4000-$8000 worth of energy per year.
- The average size windmill costs around $50,000-$80,000.
- This makes the average payoff around 10-12 years

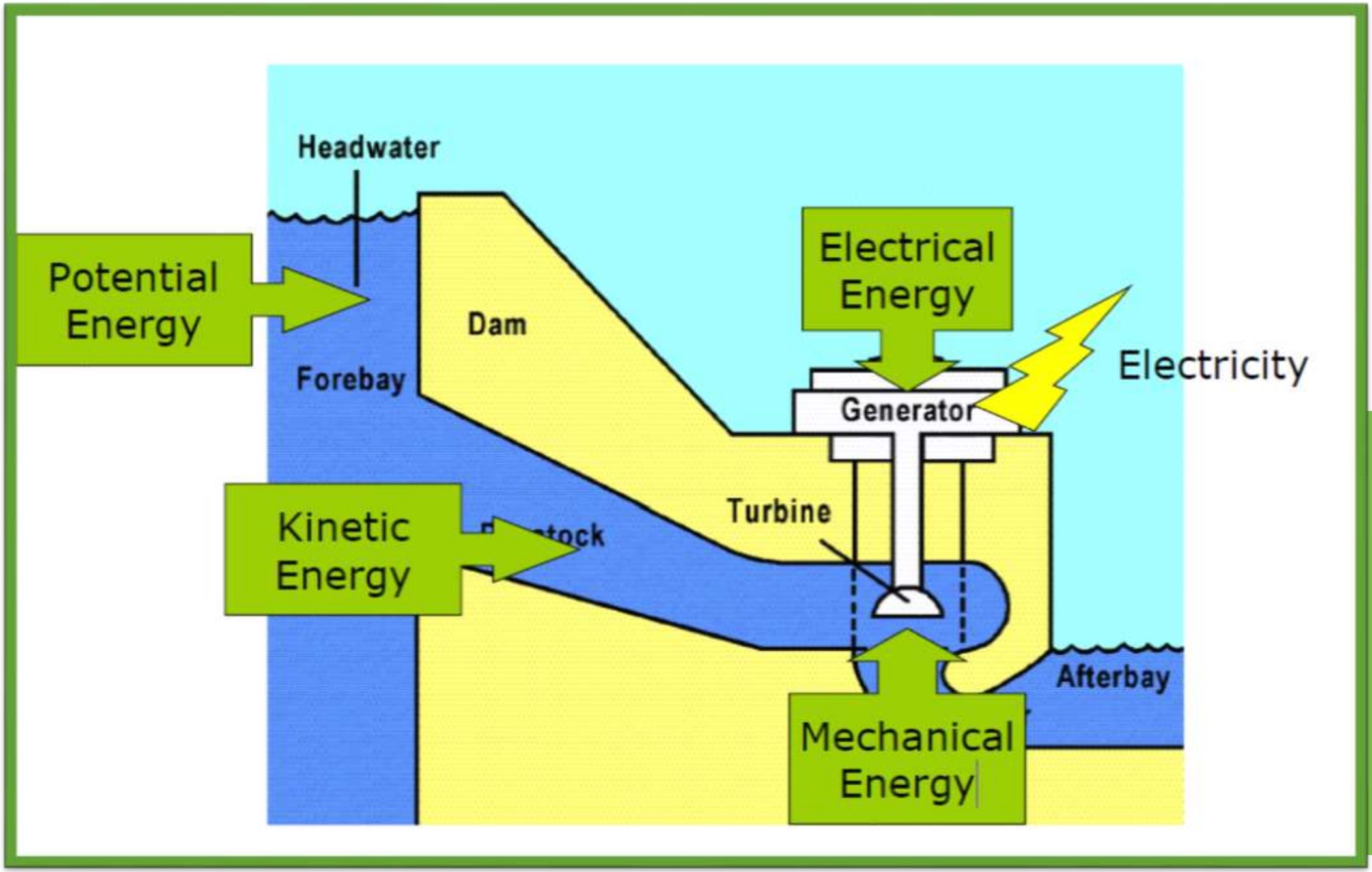
Top Common Human-caused Threats to Birds



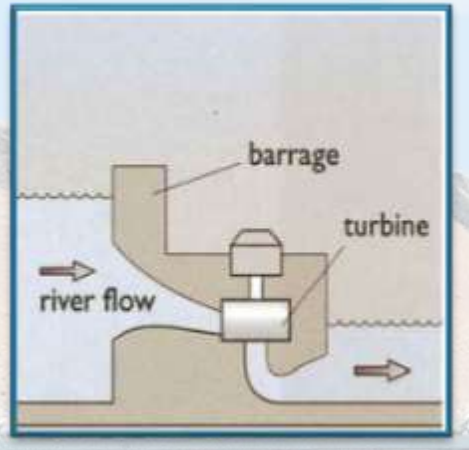
Hydro Energy

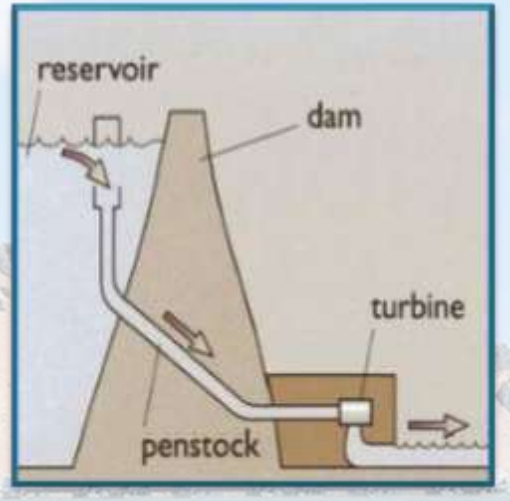


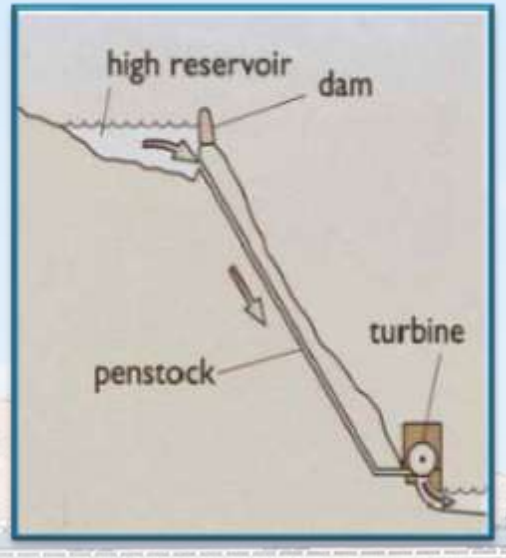
Hydrologic Cycle



Hydropower to Electric Power







Low Head

In this case small dam is built across the river to provide the necessary head.

Medium Head

The fore bay provided at the beginning of Penstock serves as water reservoir for such plants. In these plants water is generally carried out in open canals from reservoir to the Fore bay and then to the penstock.

High Head

This plants works above 500 meters and Pelton wheel turbines are commonly used. In this plant water is carried out from the main reservoir by a tunnel up to surge tank and then from the surge tank to the powerhouse in penstock.

Micro Hydropower

It has a capacity of up to 100 kilowatts. A small or micro hydroelectric power system can produce enough electricity for a home, farm, ranch, or Village.

Small Hydropower

It defines small hydropower as projects that generate 10 MW or less of power.

Large Hydropower

It defines large hydropower as facilities that have a capacity of more than 30 megawatts (MW).

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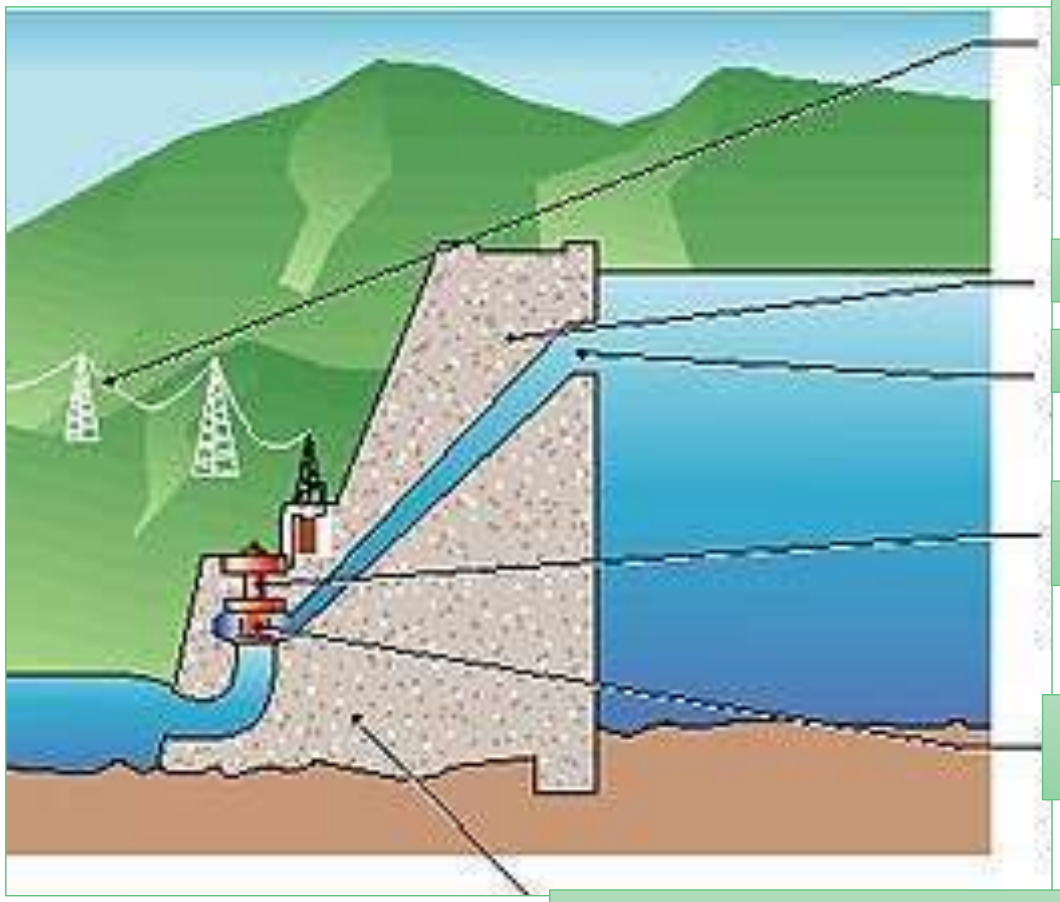
Impoundment Hydroelectric



Transmission lines conduct electricity ultimately to homes and businesses

Dam- stores water

Penstock- Carries water to turbines

Generators –roated by the turbines to generate electricity

Turbines- turned by the force of the water on their baldes

Cross Section of conventional hydropower facility that uses a dam

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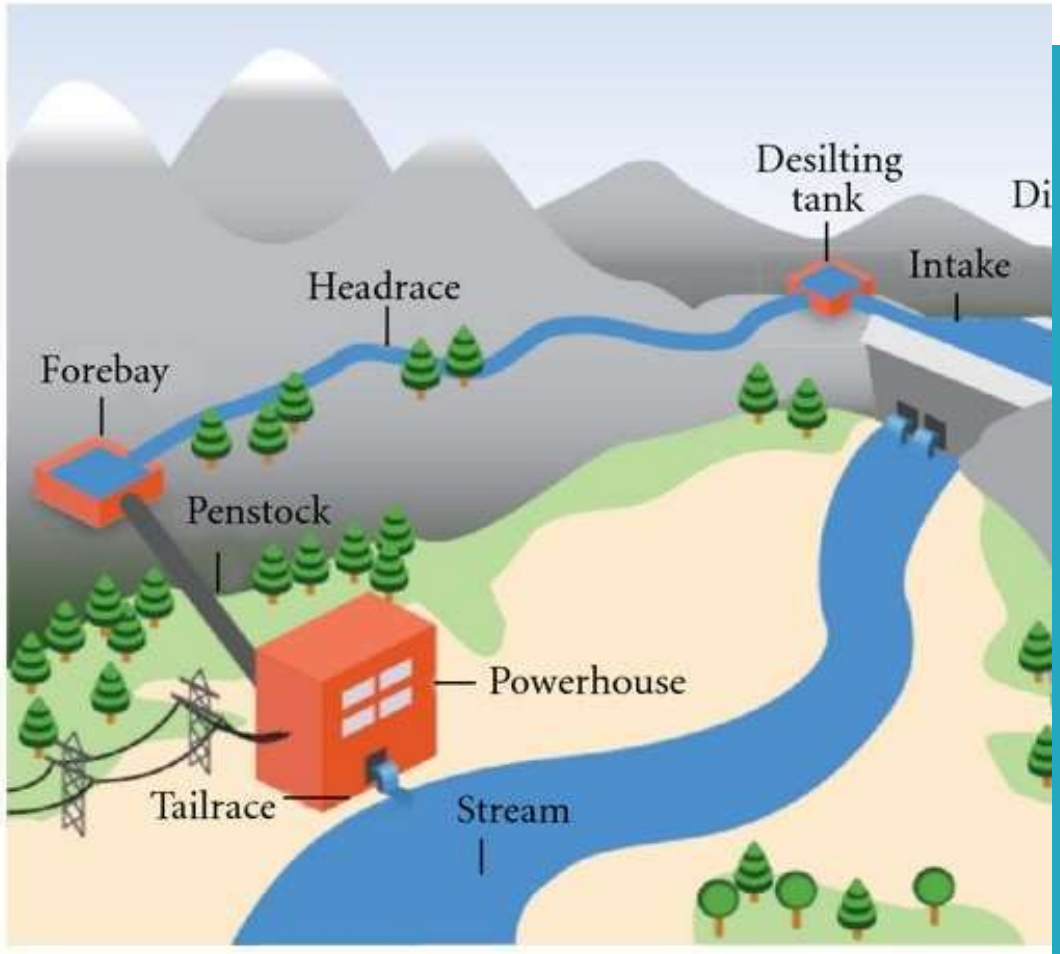

IMPOUNDMENT

- A diversion, sometimes called runof-river, facility channels a portion of a river through a canal or penstock.
- It may not require the use of a dam.

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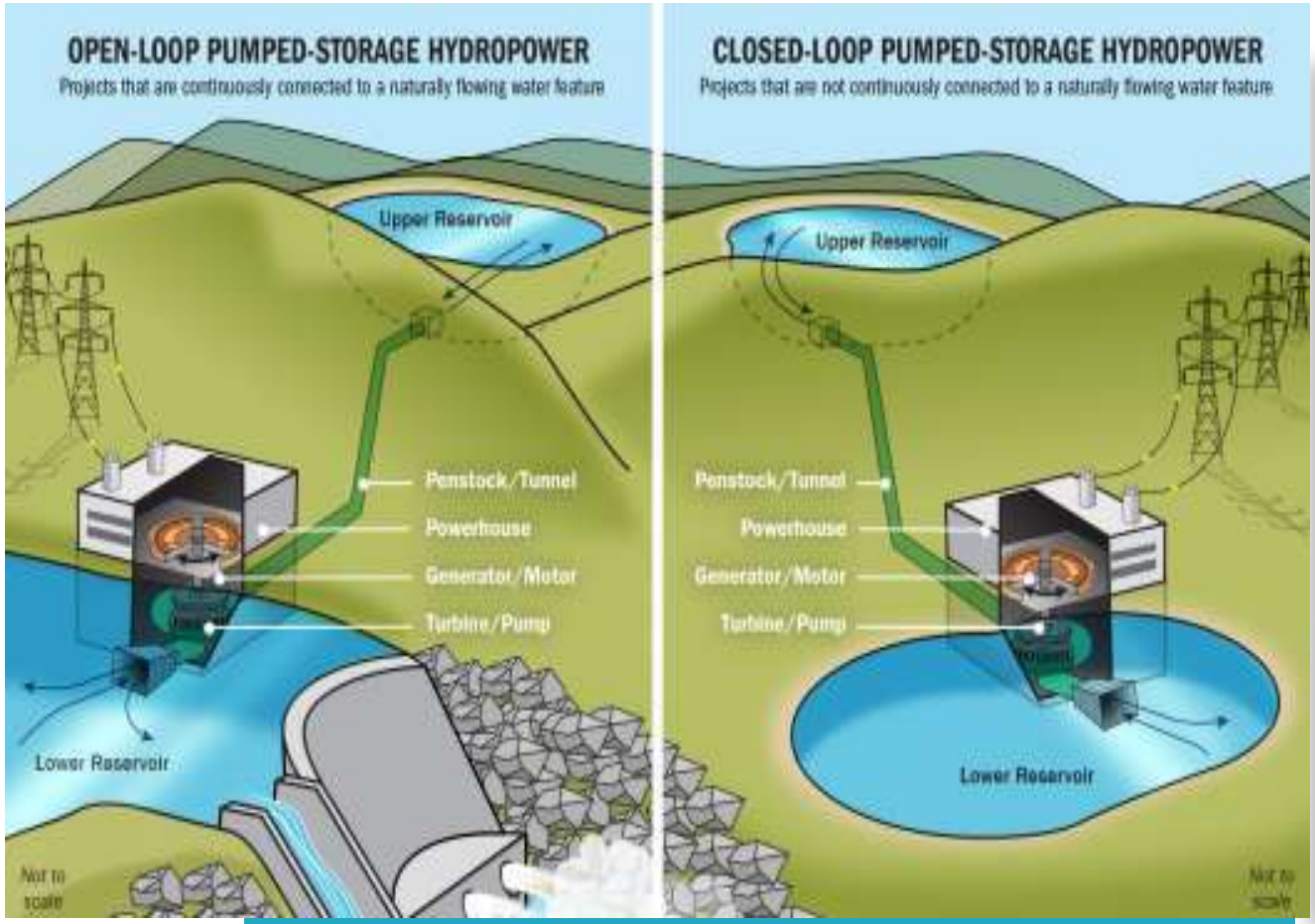
DIVERSION

- The most common type of hydroelectricpower plant is an impoundment facility.
- Animpoundment facility, typically a large hydropower system, uses a dam to store river water in a reservoir.
- Water release drom the reservoir flows through a turbine, spinning it, which in turn activates a generator to produce electricity.
- The water may be released either to meet changing electricity needs or to maintain a constant reservoir level.



PUMPED STORAGE

- Another type of hydropower called pumped storage Works like a battery, storing the electricity generated by other power sources like solar, wind, and nuclear for later use.
- It stores energy bypumping water uphill to a reservoir at higher elevation from a second reservoir at a lower elevation.
- When the demand for electricity is low, a pumped storage facility stores energy by pumping water from a lower reservoir to an upper reservoir.

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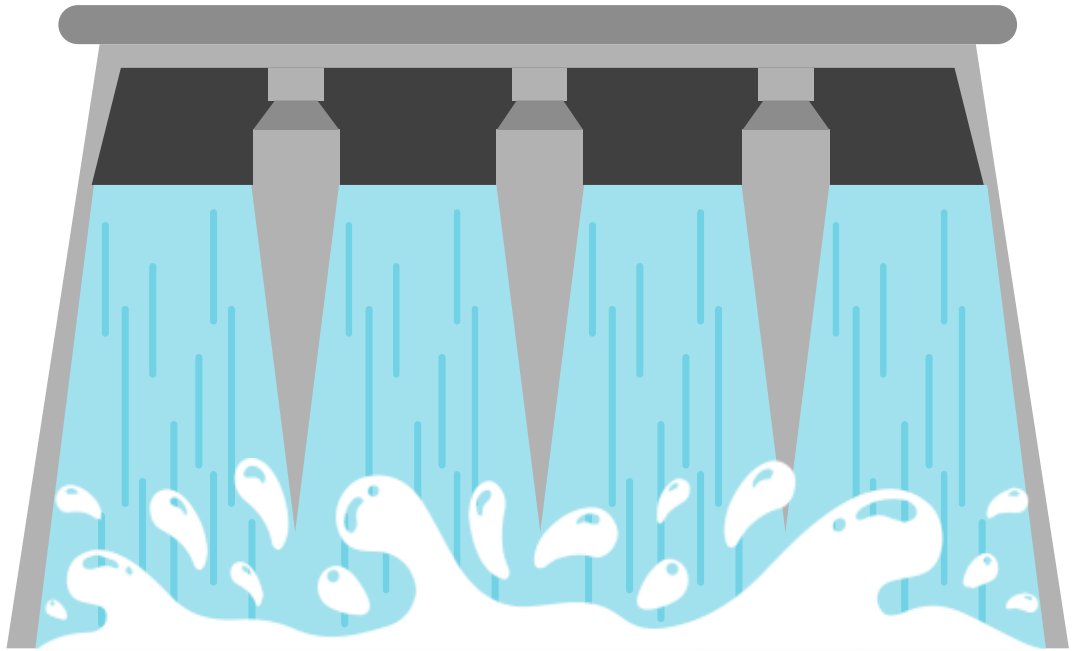
Power Generation



The amount of electricity that can be generated by a hydropower plant depends on two factors:

• **flow rate** - the quantity of water flowing in a given time; and

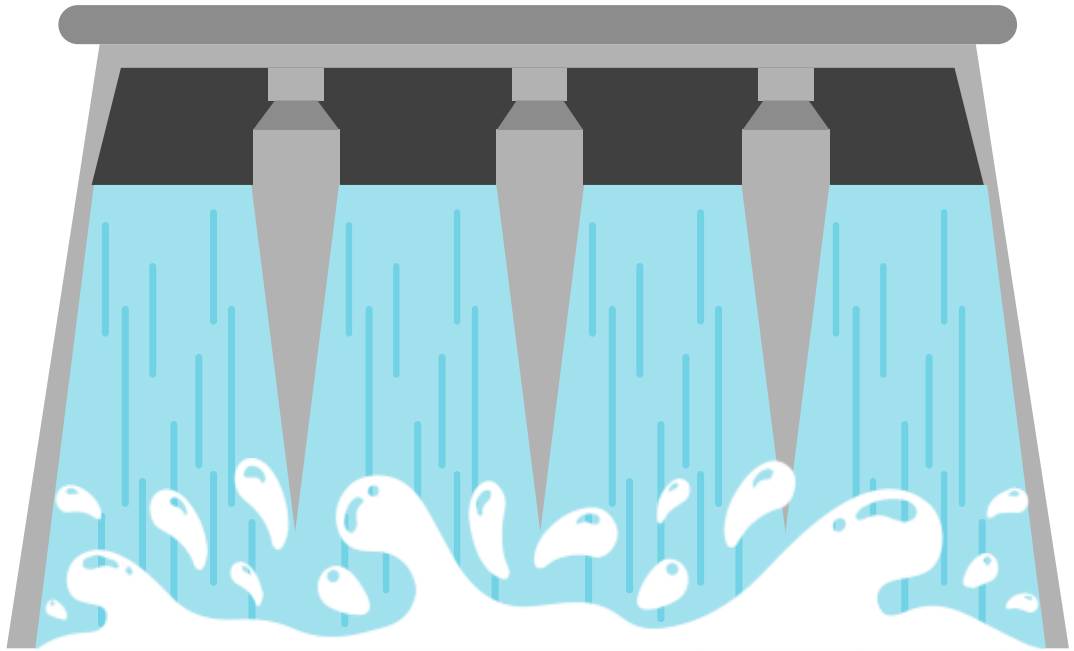
• **head** - the height from which the water falls.

The greater the flow and head, the more electricity produced.

Flow Rate = the quantity of water flowing

Head = the height from which water falls

Power Generation



A standard equation for calculating energy production:

Power = (Head) x (Flow) x (Efficiency)/11,8

Power = the electric power in kilowatts or kW

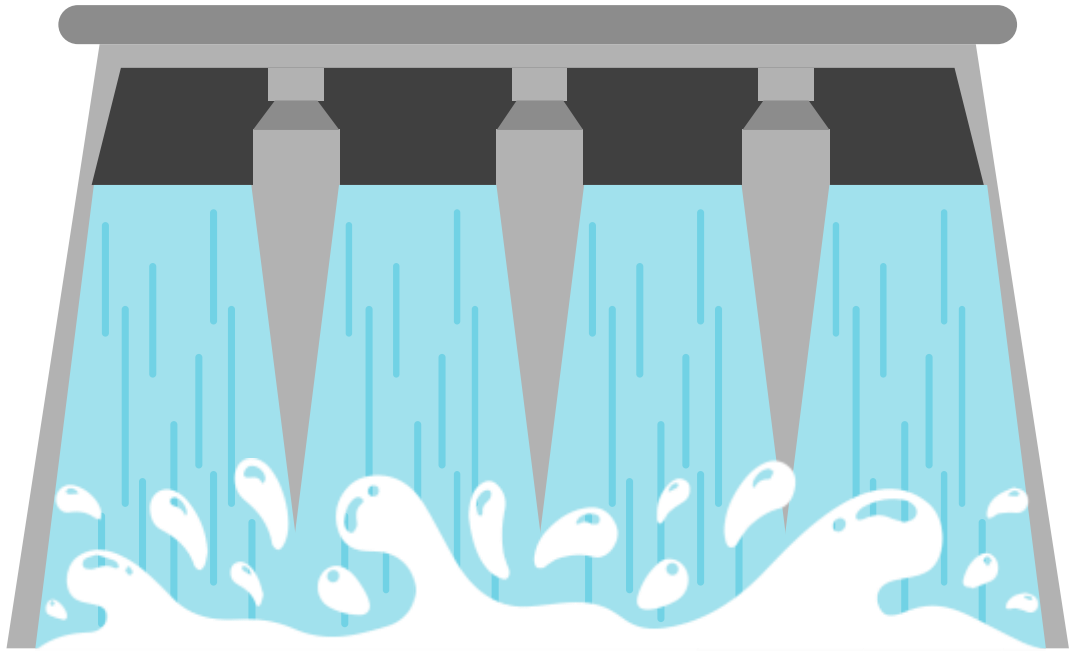
Head = the distance the water falls (measured in feet)

Flow = the amount of water flowing (measured in cubic feet per second or **cfs**)

Efficiency = How well the turbine and generator convert the power of falling water into electric power. This can range from 60% (0.60) for older, poorly maintained hydroplants to 90% (0.90) for newer, well maintained plants.

11.8 = Index that converts units of feet and seconds into kilowatts

Power Generation



As an example, let's see how much power can be generated by the power plant.

The dam is 357 feet high, the **head** (distance the water falls) is 235 feet. The typical **flow rate** is 2200 cfs. Let's say the turbine and generator are 80% efficient.

Power = (Head) x (Flow) x (Efficiency)/11.8

Power = 235ft. x 2200 cfs x .80/11.8

Power = 517,000 x .80/11,8

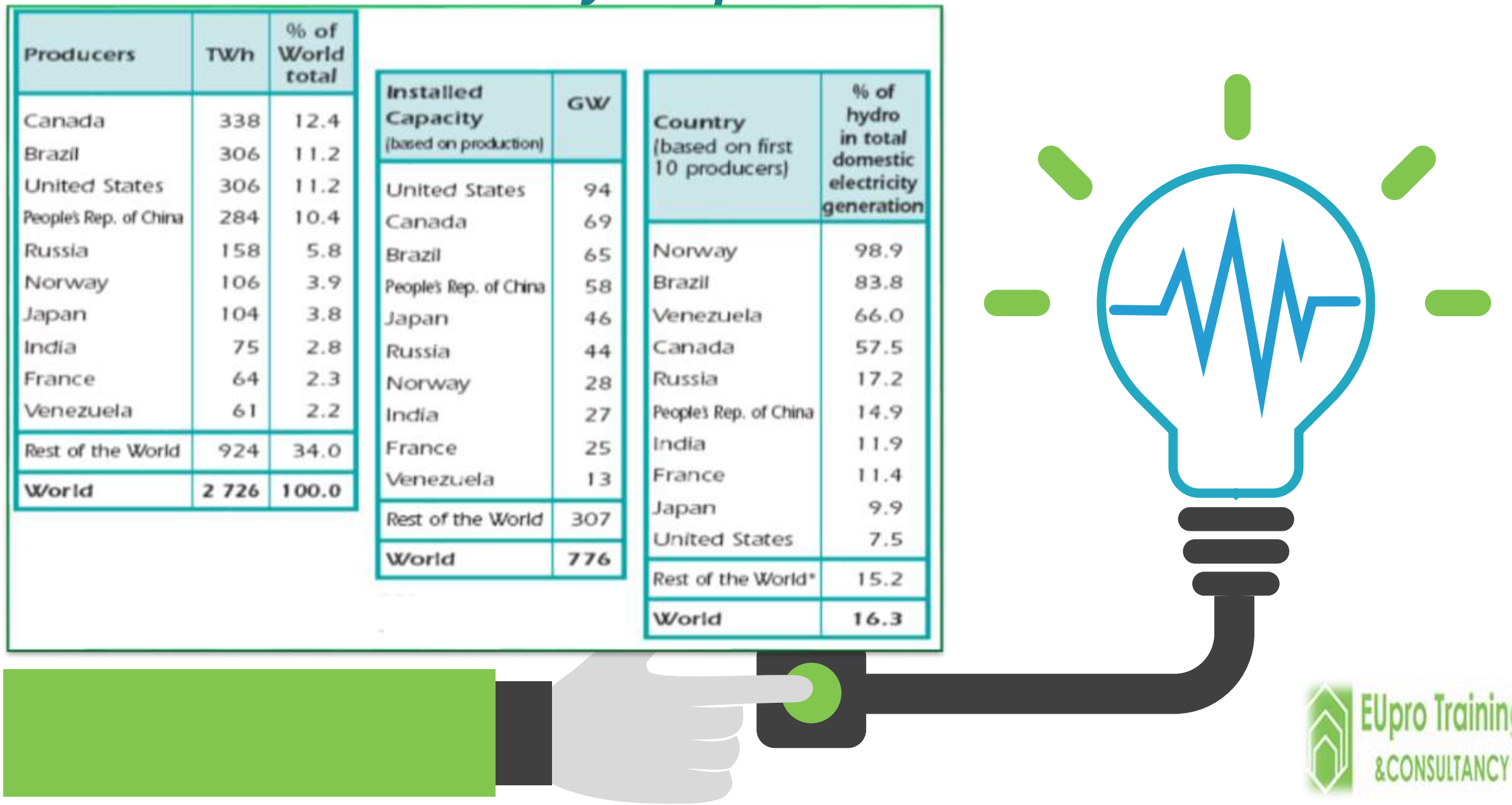
Power = 35,051 kilowatts (kW)

World hydro production

Producers	TWh	% of World total
Canada	338	12.4
Brazil	306	11.2
United States	306	11.2
People's Rep. of China	284	10.4
Russia	158	5.8
Norway	106	3.9
Japan	104	3.8
India	75	2.8
France	64	2.3
Venezuela	61	2.2
Rest of the World	924	34.0
World	**2 726**	**100.0**

Installed Capacity (based on production)	GW
United States	94
Canada	69
Brazil	65
People's Rep. of China	58
Japan	46
Russia	44
Norway	28
India	27
France	25
Venezuela	13
Rest of the World	307
World	**776**

Country (based on first 10 producers)	% of hydro in total domestic electricity generation
Norway	98.9
Brazil	83.8
Venezuela	66.0
Canada	57.5
Russia	17.2
People's Rep. of China	14.9
India	11.9
France	11.4
Japan	9.9
United States	7.5
Rest of the World*	15.2
World	**16.3**



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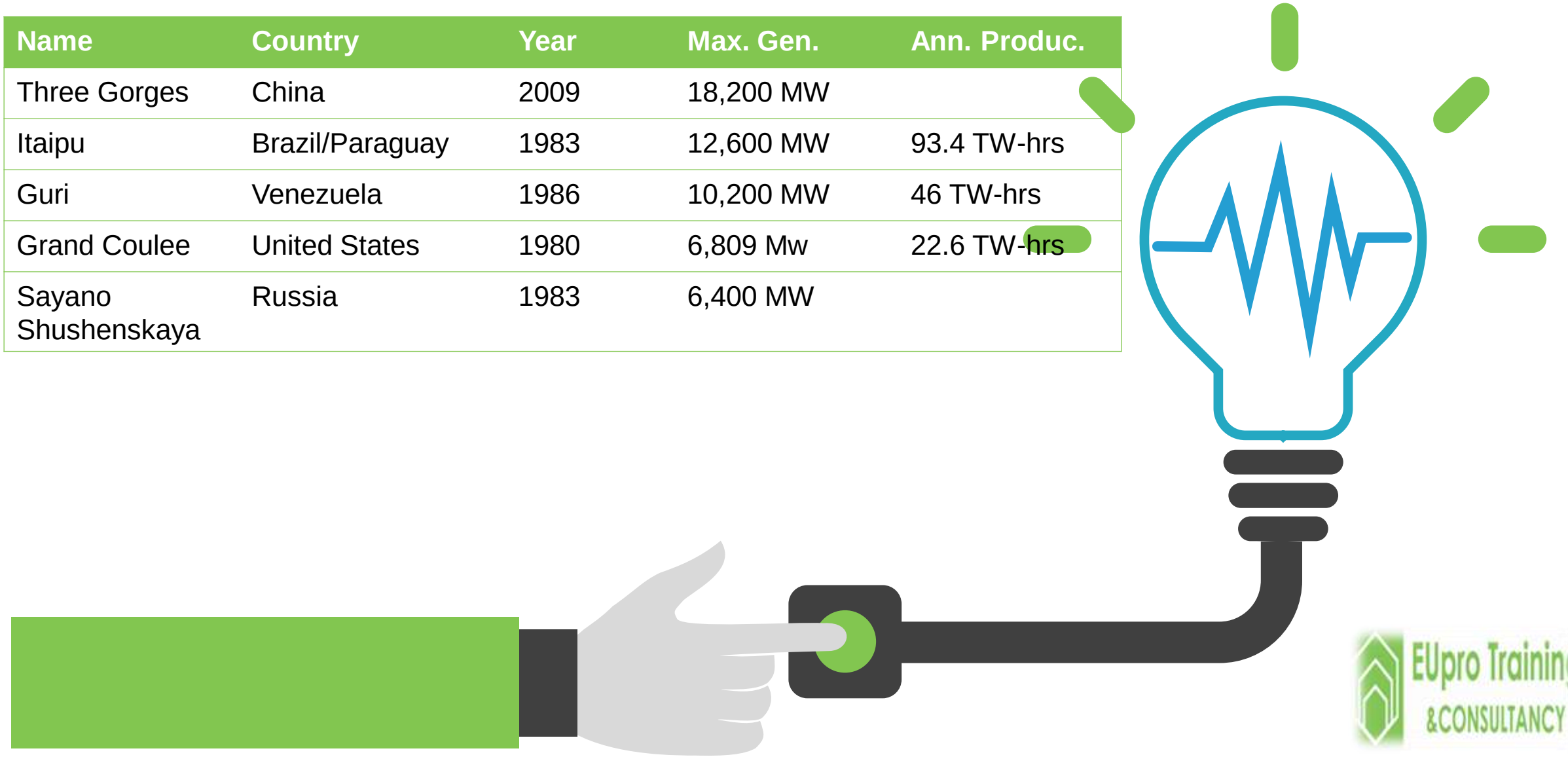
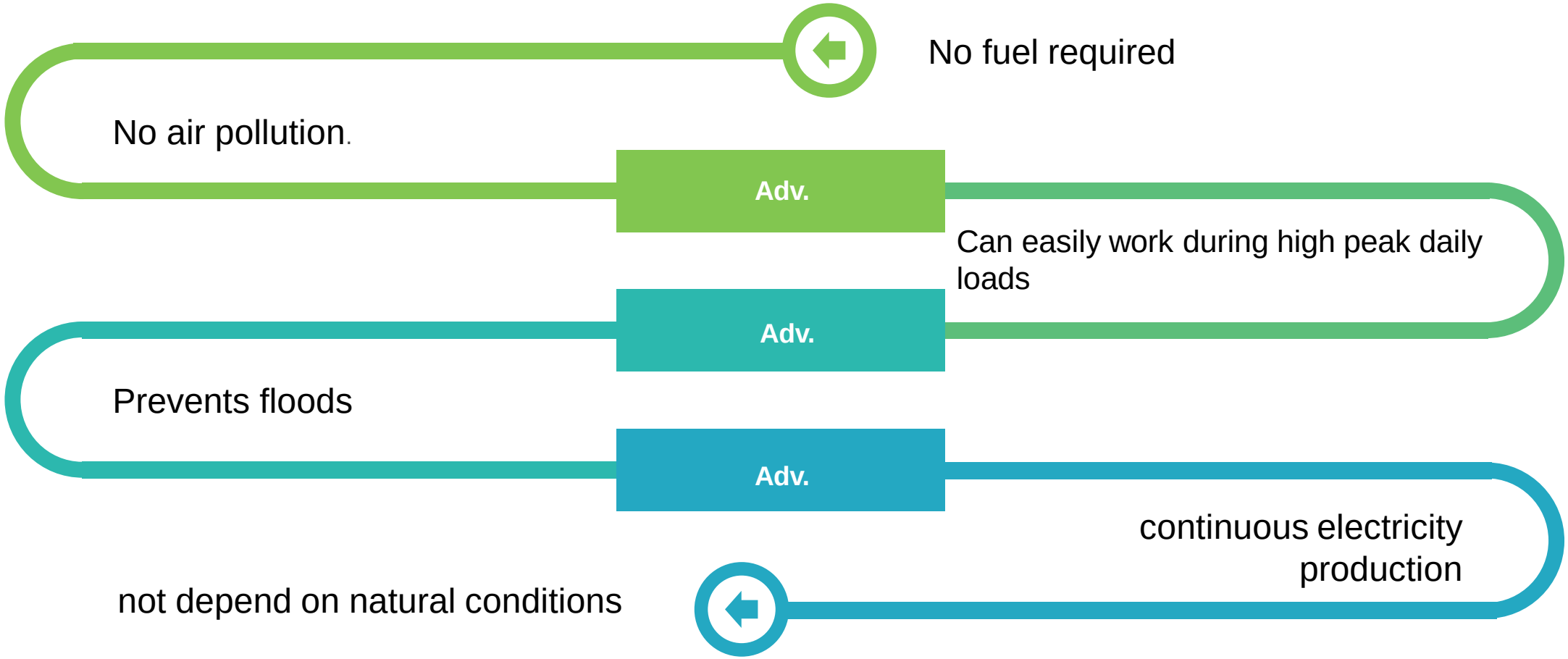
World's Largest Dams

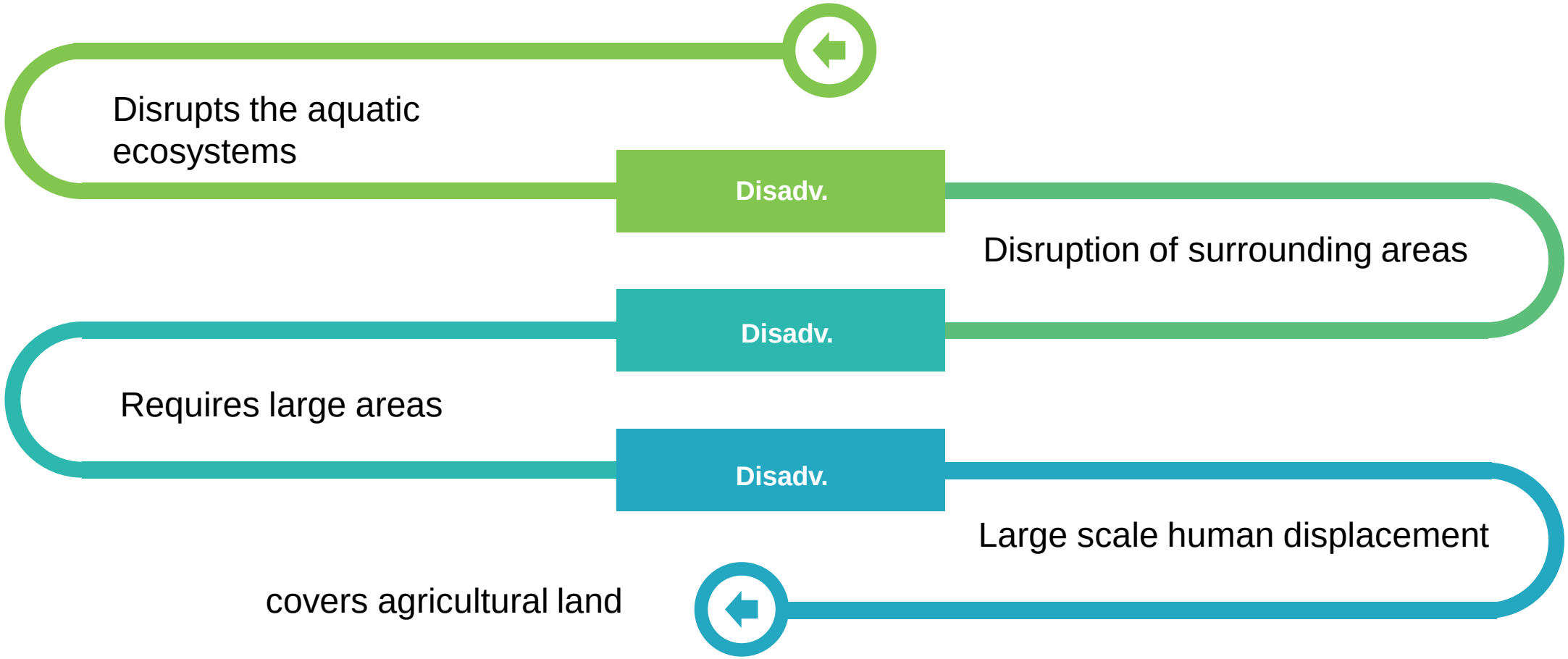
Name	Country	Year	Max. Gen.	Ann. Produc.
Three Gorges	China	2009	18,200 MW	
Itaipu	Brazil/Paraguay	1983	12,600 MW	93.4 TW-hrs
Guri	Venezuela	1986	10,200 MW	46 TW-hrs
Grand Coulee	United States	1980	6,809 Mw	22.6 TW-hrs
Sayano Shushenskaya	Russia	1983	6,400 MW	



Advantages


No fuel required
No air pollution.
Adv.
Can easily work during high peak daily loads
Adv.
Prevents floods
Adv.
continuous electricity production
not depend on natural conditions

Disadvantages



Biomass Energy

Biomass Energy

Renewable energy from plants and animals

Biomass is a renewable energy source and can be anything from energy crops to agricultural or forestry residues and biogenic waste

Biomass can be used to produce both heat and electricity.

It plays a key role in reducing CO2 emissions from existing coal power plants by co-firing and producing green heat.

Converting Biomass to Energy

01

Biogas

Biogas forms when paper, food scraps, and yard waste decompose in landfills, and it can be produced by processing sewage and animal manure in special vessels called digesters

02

Ethanol

Ethanol is made from crops such as corn and sugar cane that are fermented to produce fuel ethanol for use in vehicles.

03

Biodiesel

Biodiesel is produced from vegetable oils and animal fats and can be used in vehicles and as heating oil.

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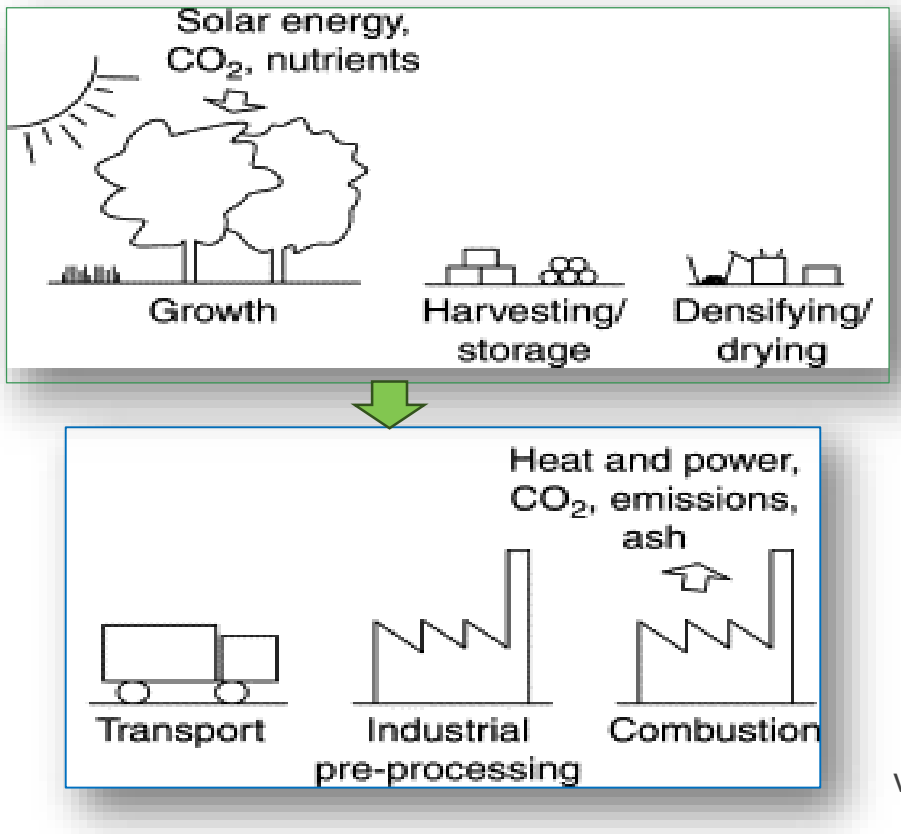
Direct Combustion

1

Bioenergy uses biomass to create fuel. Examples of biomass include wood waste, bagasse (sugar cane residues), and animal fats. This waste is processed in different ways to create energy.



2

The direct combustion of biomass in presence of oxygen/air to produce heat and by products is called direct combustion.

3

One method includes directly burning the biomass to release energy in the form of heat which can be used to generate electricity. There's also chemical conversion.

4

This heat energy in the product gases or in the form of steam can be used for various applications like space heating or cooling, power generation, process heating in industries or any other application.

Biochemical Conversion

Biochemical conversion of biomass involves use of bacteria, microorganisms and enzymes to breakdown biomass into gaseous or liquid fuels, such as biogas or bioethanol.

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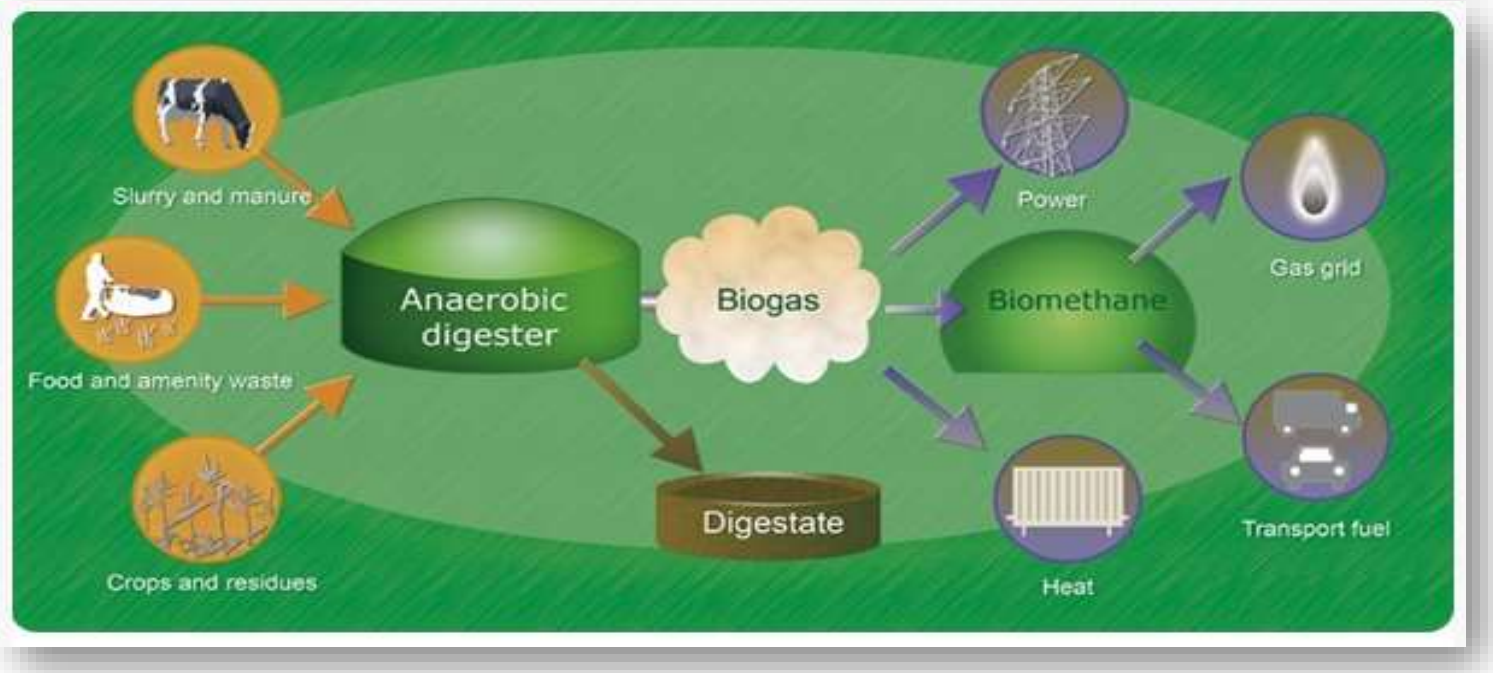
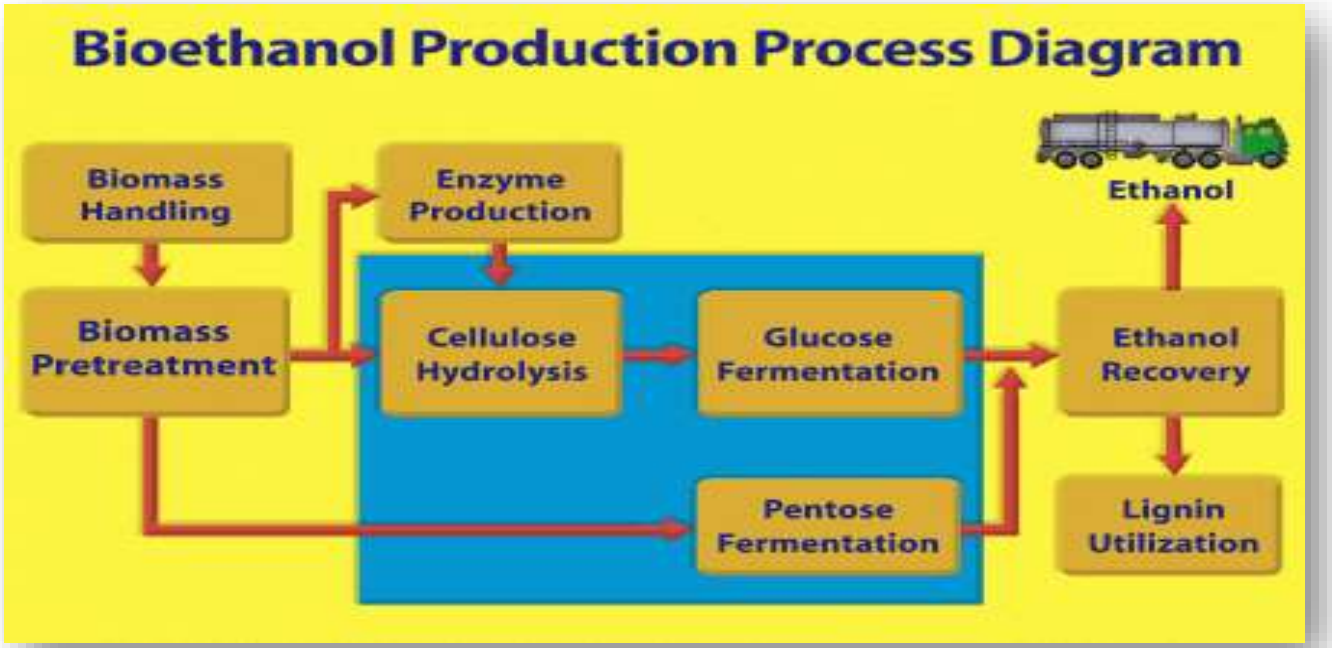
Anaerobic Digestion



Anaerobic digestion is a series of chemical reactions during which organic material is decomposed through the metabolic pathways of naturally occurring microorganisms in an oxygen depleted environment.

Ethanol Fermentation



It involves the conversion of sugar rich biomass plants into alcohol through the addition of bacteria, yeasts and enzymes.

The same process is further extended to include distillation to obtain Ethanol (ethyl alcohol). Ethanol is used as a green substitute for gasoline or as a fuel enhancer.

Biodiesel

Biodiesel can be sourced from plants like soybeans, rapeseed, palm, corn, sunflower and animal fats like tallow, poultry fats and fish oils and even used cooking oils from restaurants

Biodiesel is widely produced and consumed in the European Union as a substitute for petrol and diesel.

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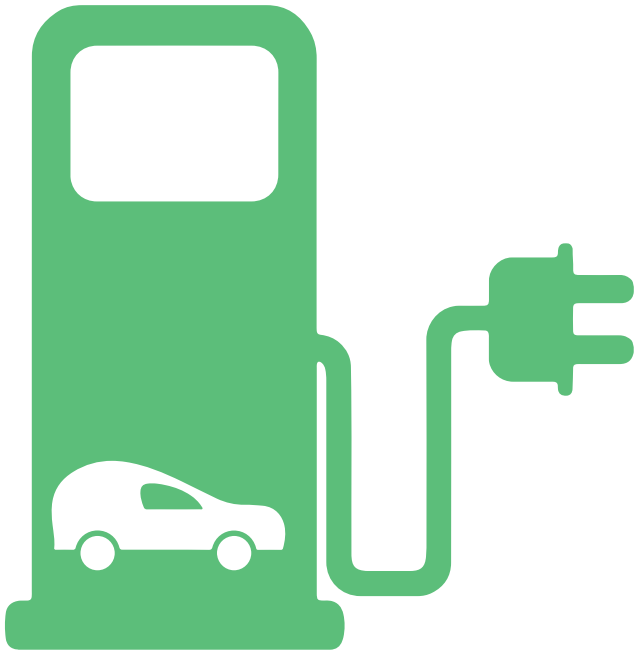
E-Diesel



Modified Waste Vegetable Fat

Designed for general use in most compression ignition engines . The production of MWVF can be achieved in a continuous flow additive process.

It can be modified in various ways to make a 'greener' form of fuel

E-Diesel

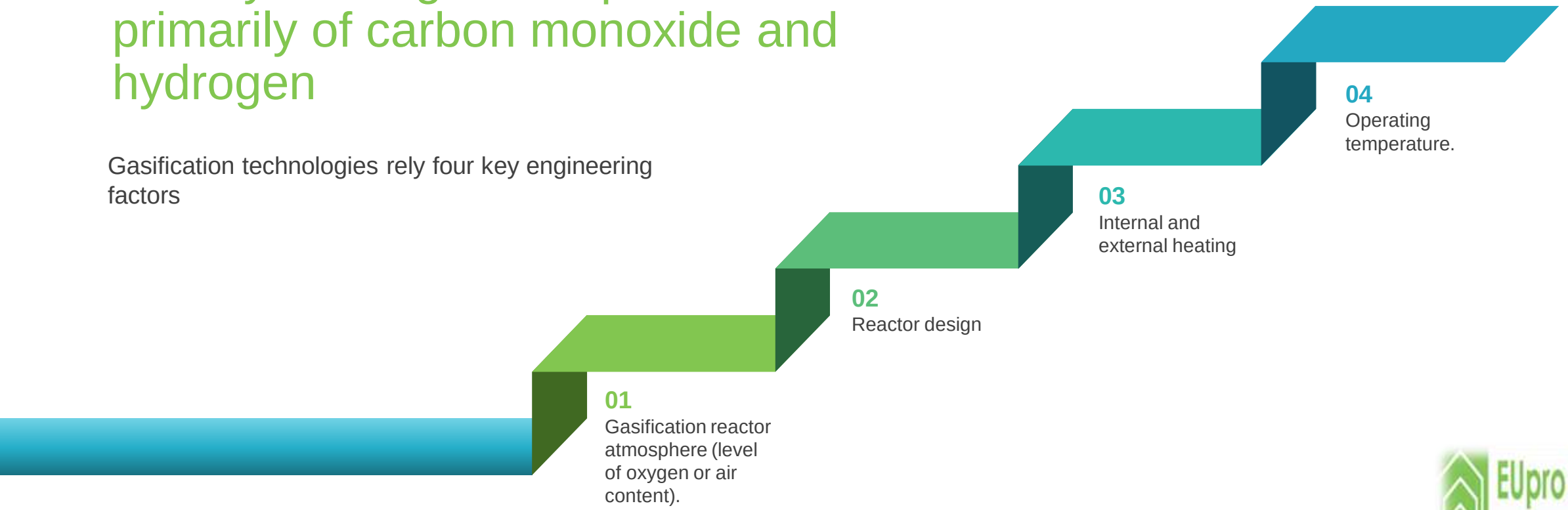
Uses additives in order to allow blending of ethanol with diesel. Ethanol blends of 7.7% to 15% and up to 5%

Additives that prevent the ethanol and diesel from separating at very low temperatures or if water contamination occurs.

Gasification

A process that uses heat, pressure, and steam to convert materials directly into a gas composed primarily of carbon monoxide and hydrogen

Gasification technologies rely four key engineering factors



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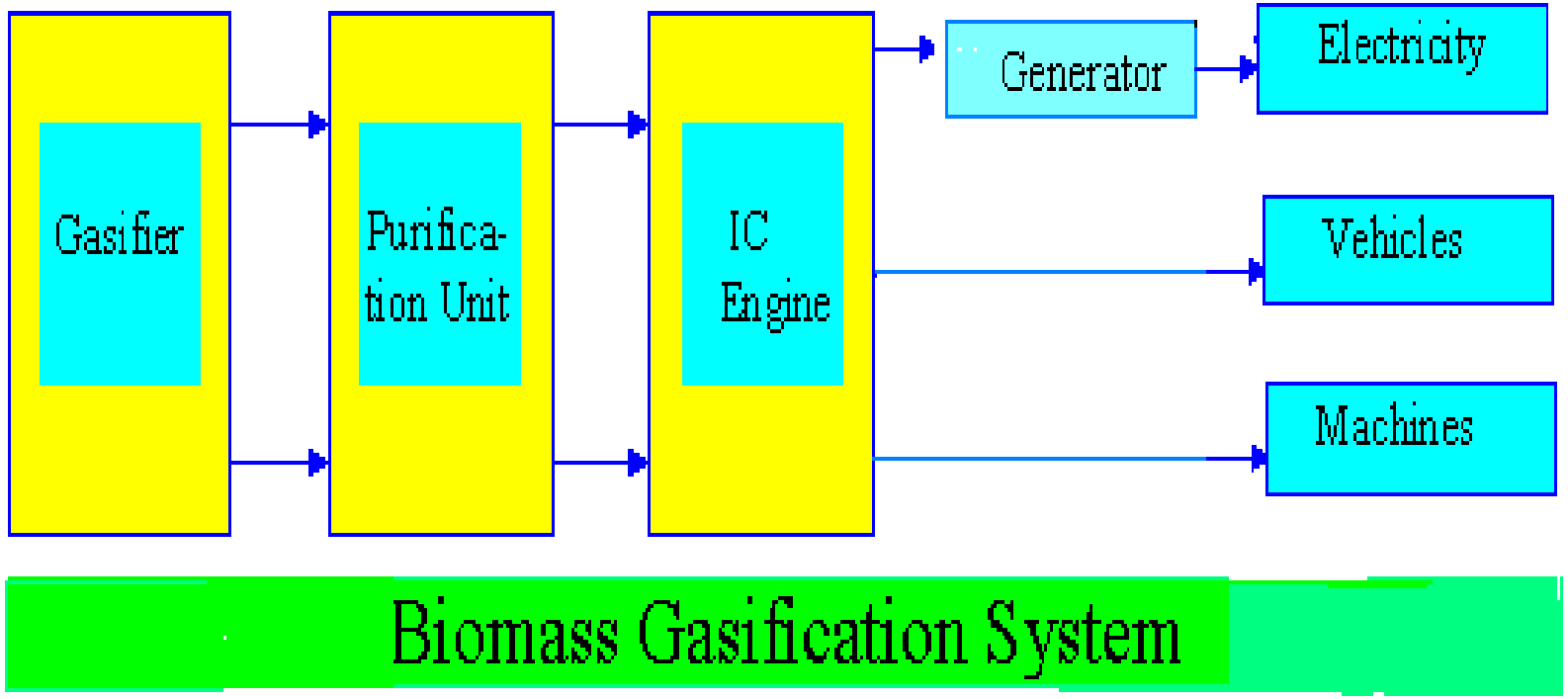
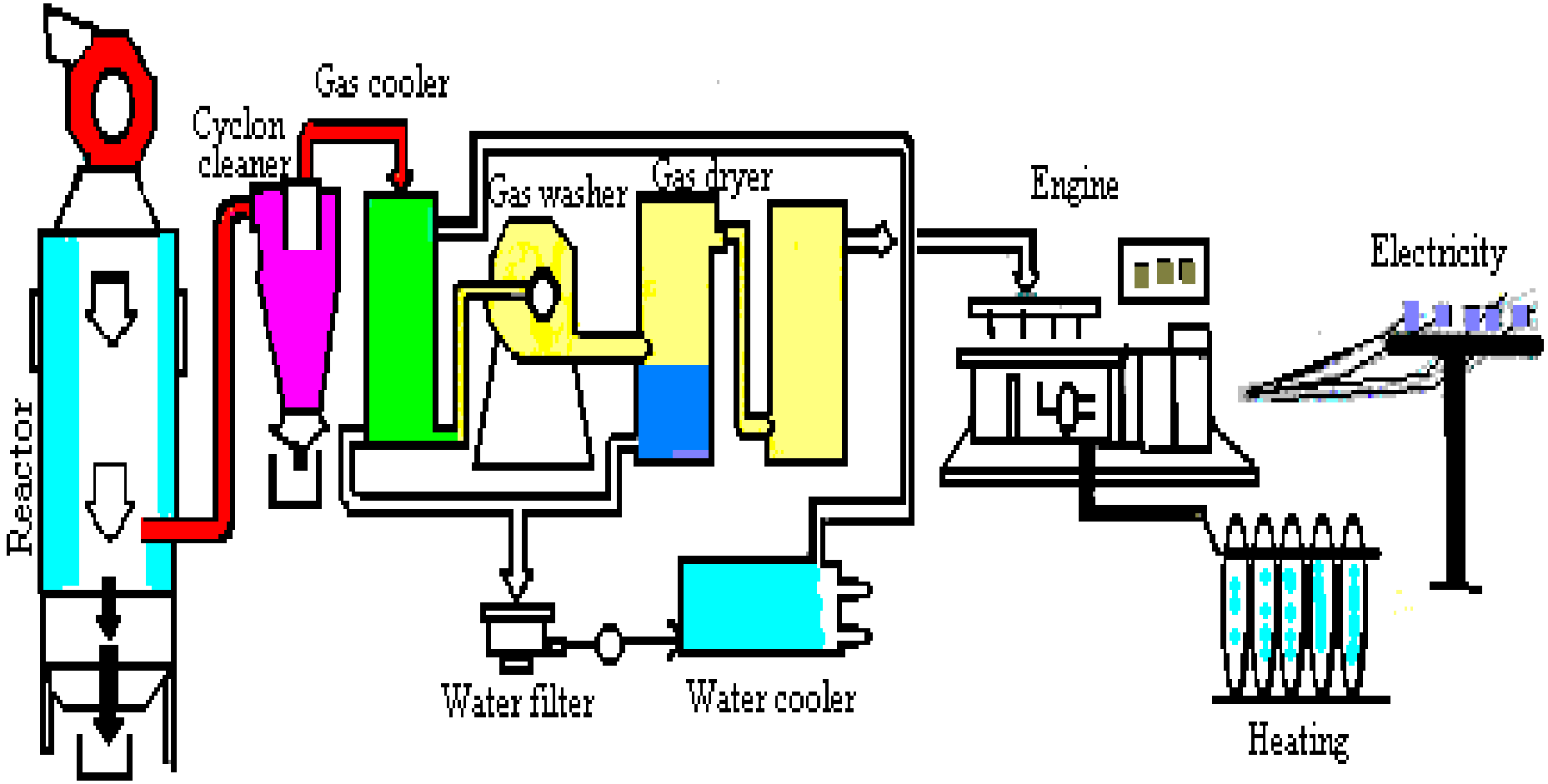
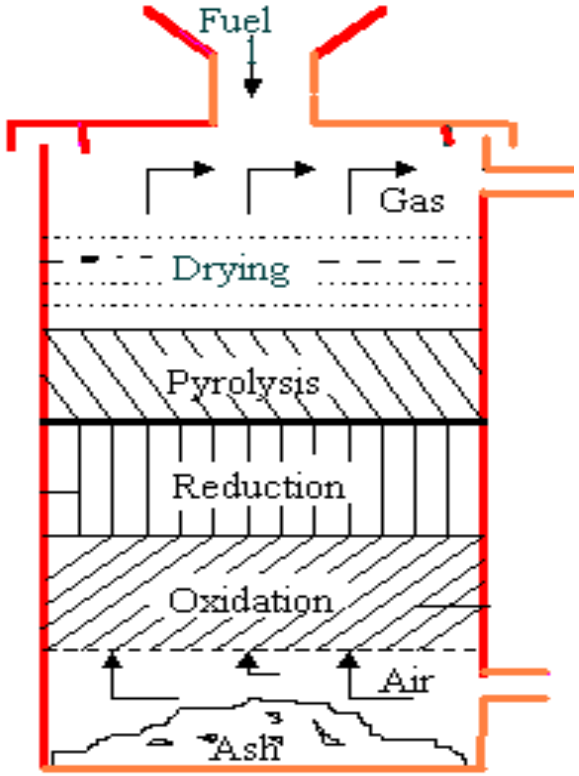
Gasifier Plant



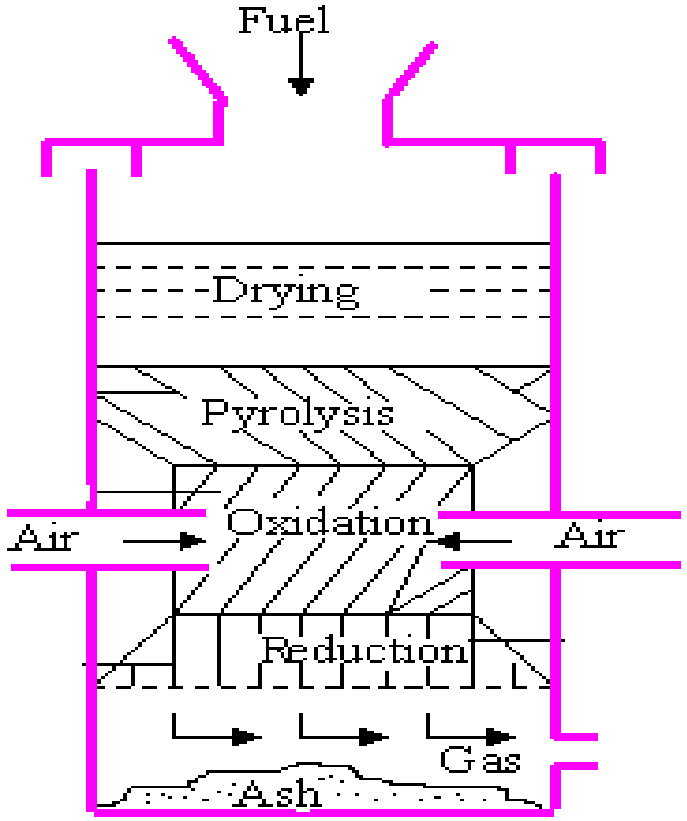
Gasifier Plant



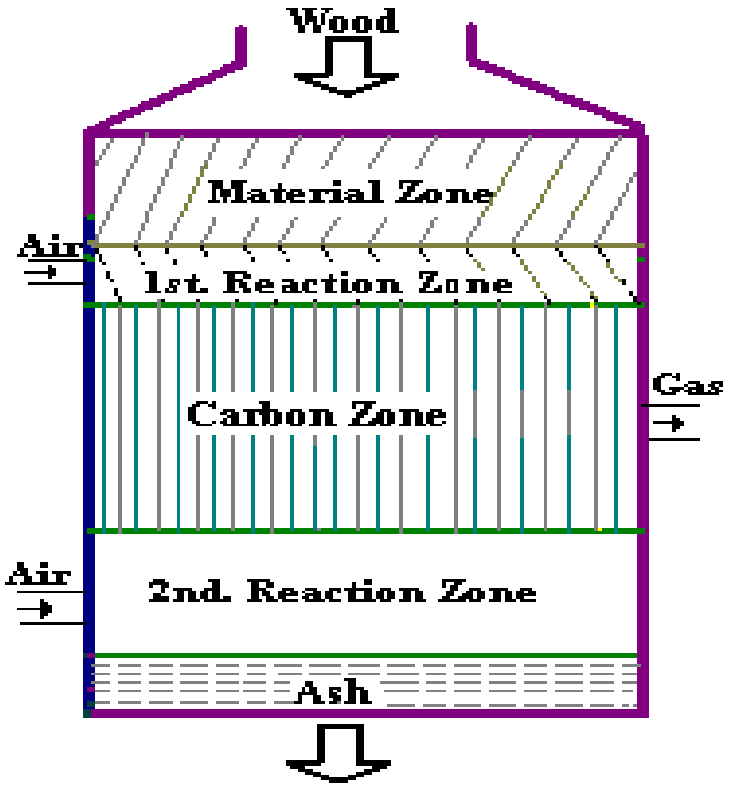
Types of Gasifiers



Updraft Gasifier

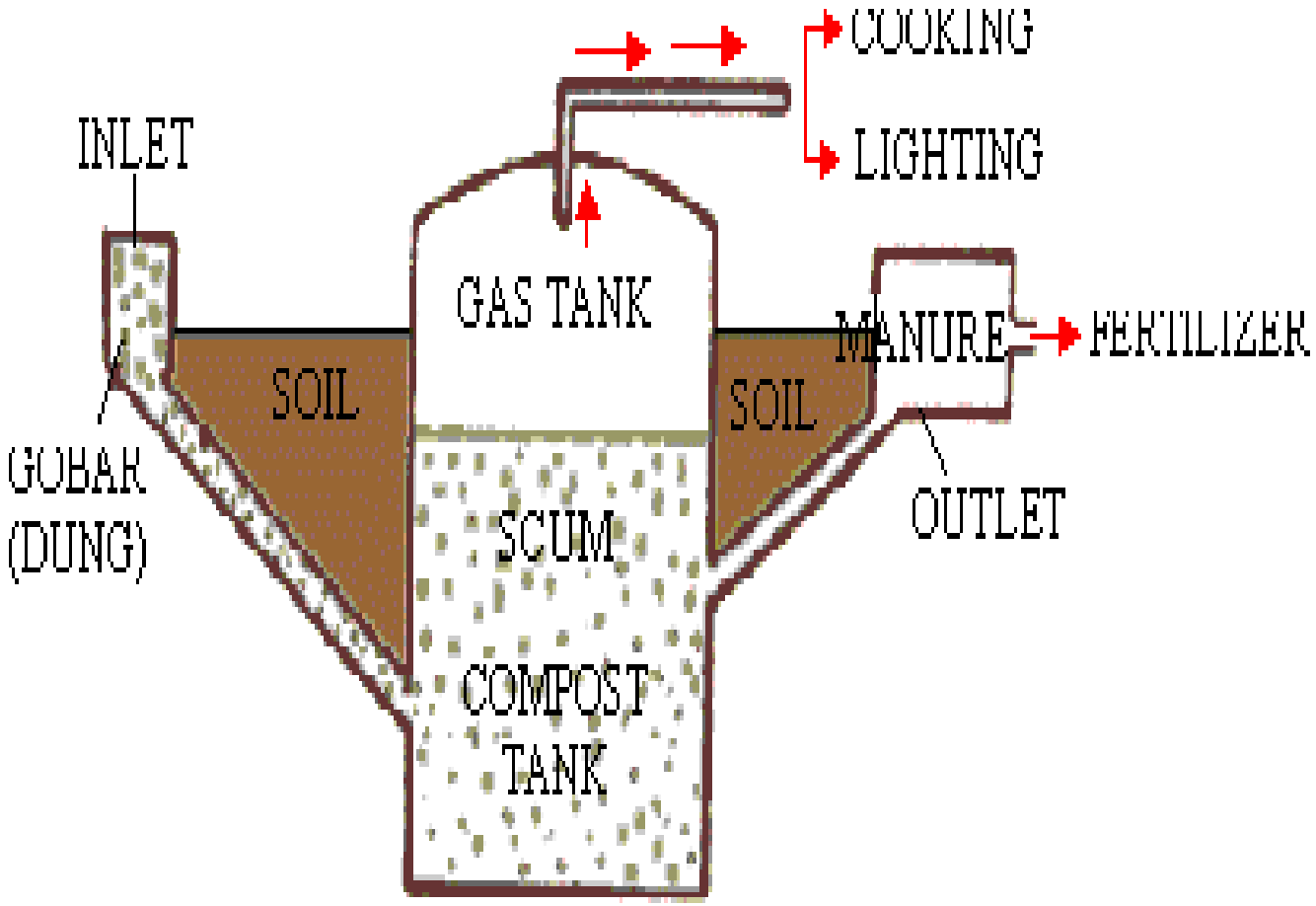


Downdraft Gasifier



Twin-fire Gasifier

Gobar Gas



Gobar gas production is an **anaerobic process**

Fermentation is carried out in an air tight, closed cylindrical concrete tank called a **digester**

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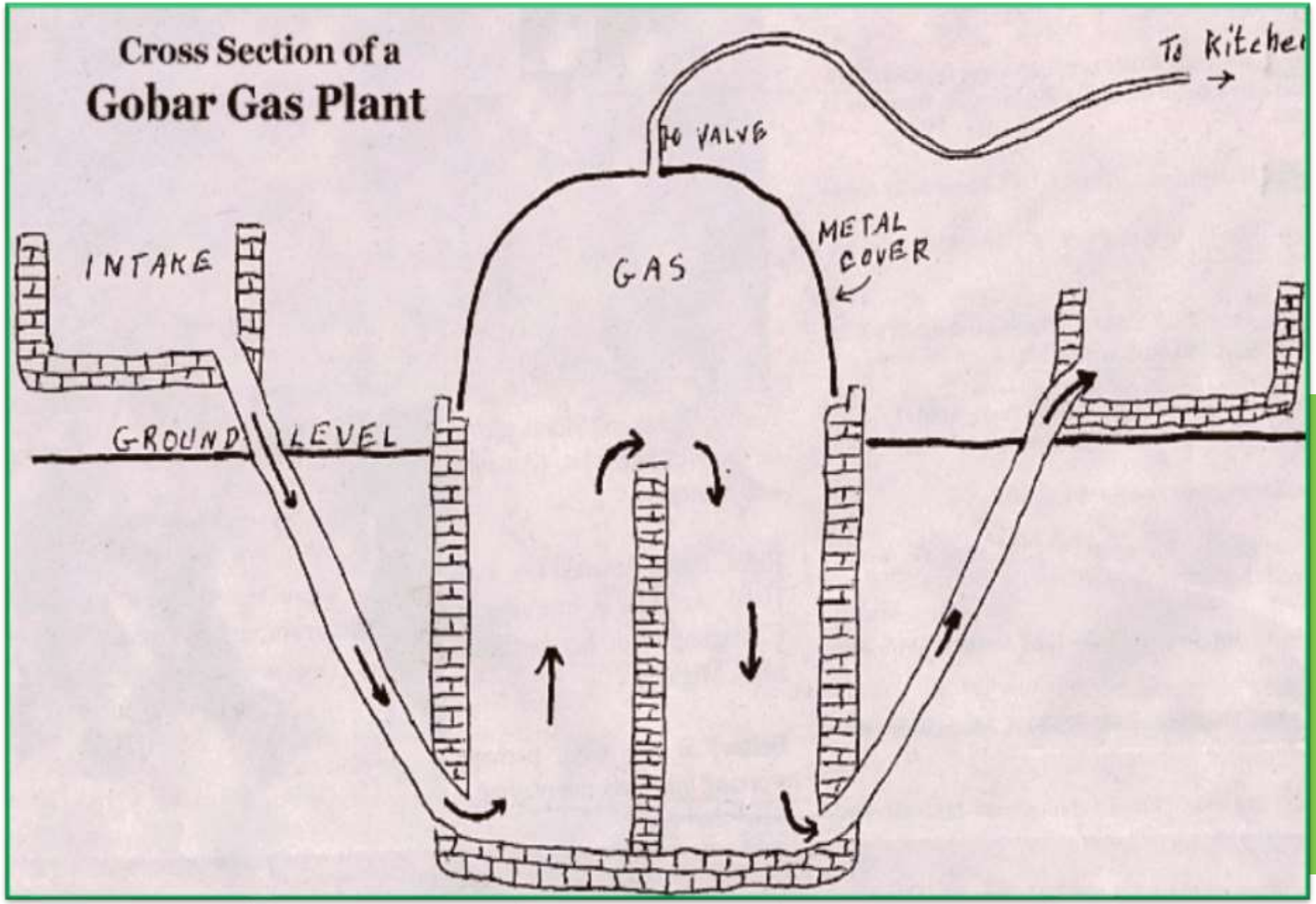

Gobar gas

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Advantages

- ✓Biomass is clean energy source

- ✓Minimizes the possibility of fill up of landfills
  Another great benefit of biomass energy is that it converts harmful wastes into useful energy.

- ✓Biomass emissions are not harmful
  Biomass energy is totally natural and doesn't present any side effects when used.
- ✓Biomass emissions are not harmful

- ✓It's a renewable resource and bountiful in supply
  Fossil fuels are non-renewable forms of energy that take years to produce.

- ✓Biomass energy dials back on fossil fuel dependence

- ✓It's versatile

Disdvantages

✓It’s comparatively inefficient to fossil fuel

Ethanol, which is a biodiesel, is inefficient against gasoline. To add to that, it is commonly blended with gasoline in order to function properly.

✓Combustion of biomass require a lot of space

Burning of biomass products require a big amount of land for ease and convenience of burning.

Thermal Storage Energy

Geothermal

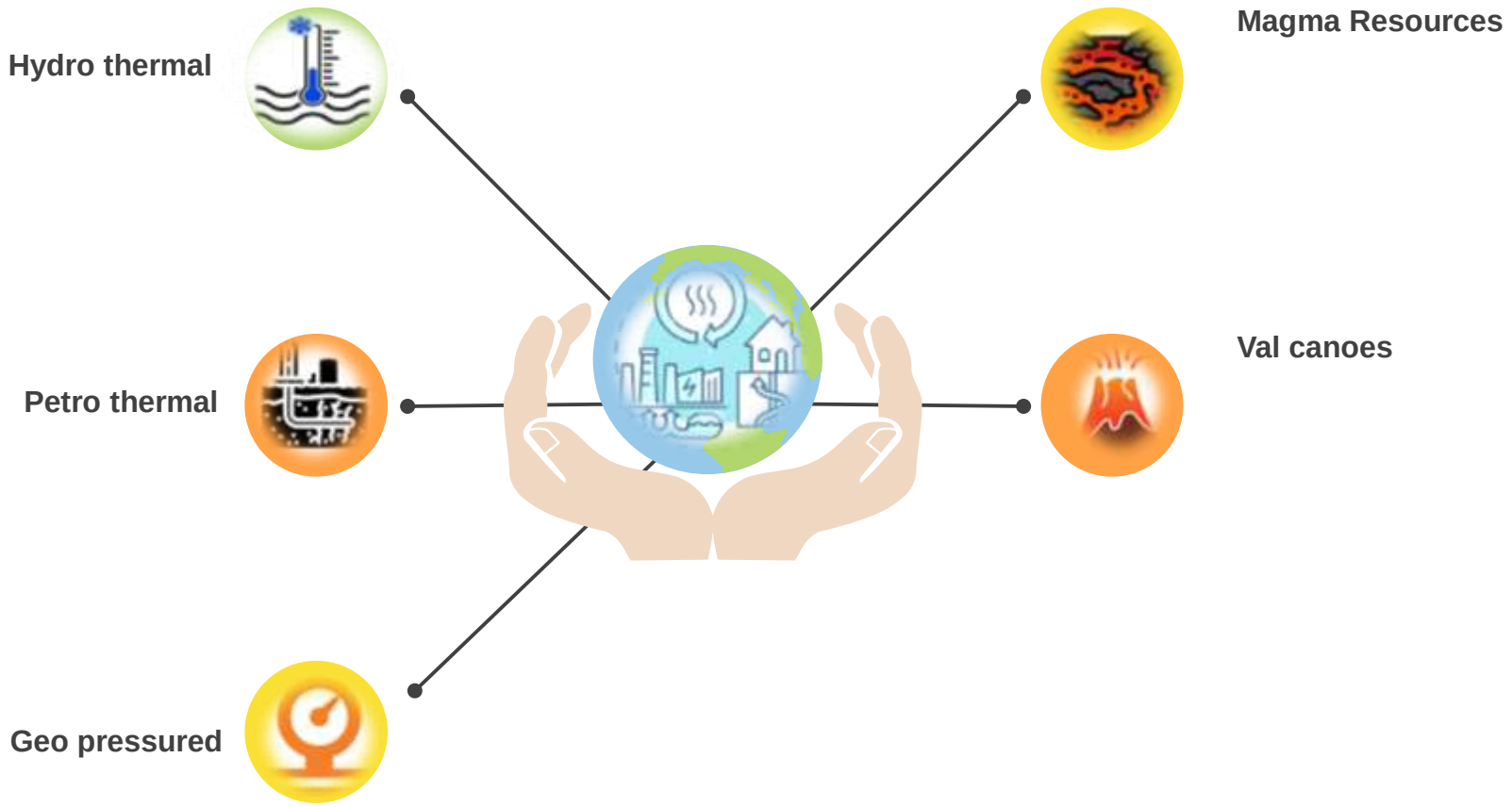
Geo Thermal

It’s means heat provide by the earth

GEO= EARTH

THERMAL=HEAT

Resources of Geothermal Energy



Generations

Direct

- Small scale uses
- Heating homes
- Hot springs
- Greenhouse heating
- Food dehydration plants
- Agriculture

Electrical

- Dry steam
- Flash steam
- Binary cycle

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Introduction

01

The earth loop is placed in the ground either horizontally or vertically, or it can be placed in a pond.

02

Water and anti freeze is circulated through the pipe, transporting heat to the heat pump during the heating mode and away from the heat pump during the cooling mode.

03

The heat transfer takes place inside the heat pump in a water to refrigerant heat exchanger.

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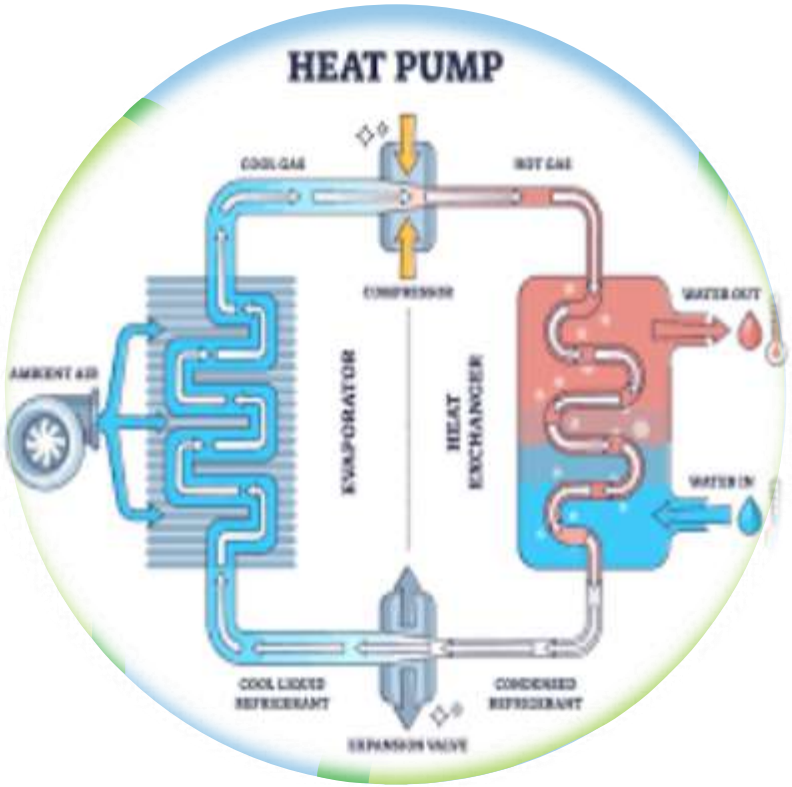
Energy Source

HE-Heat of extraction

During the heating season, the earth serves as a heat source.



HR-Heat of rejection

During the cooling season, the earth serves as a heat sink.

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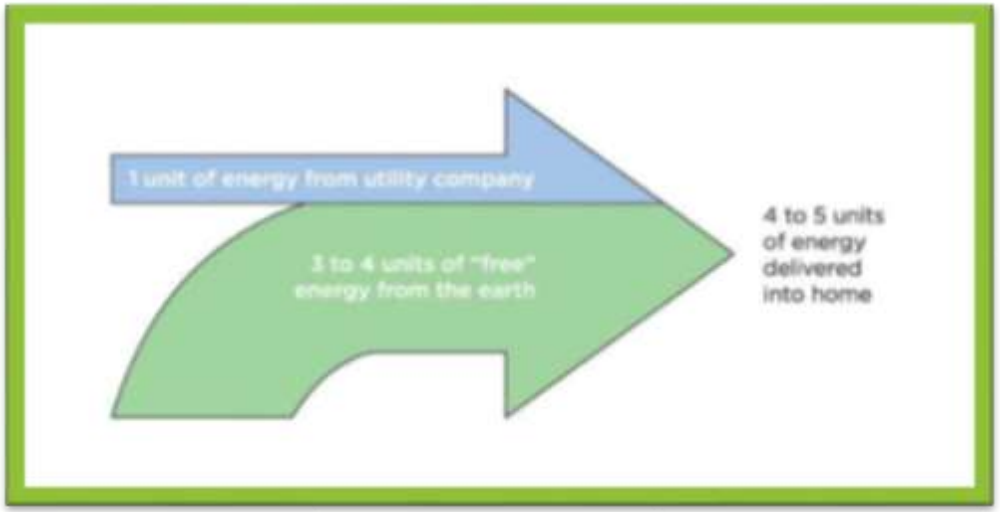
Equipment Performance Ratings



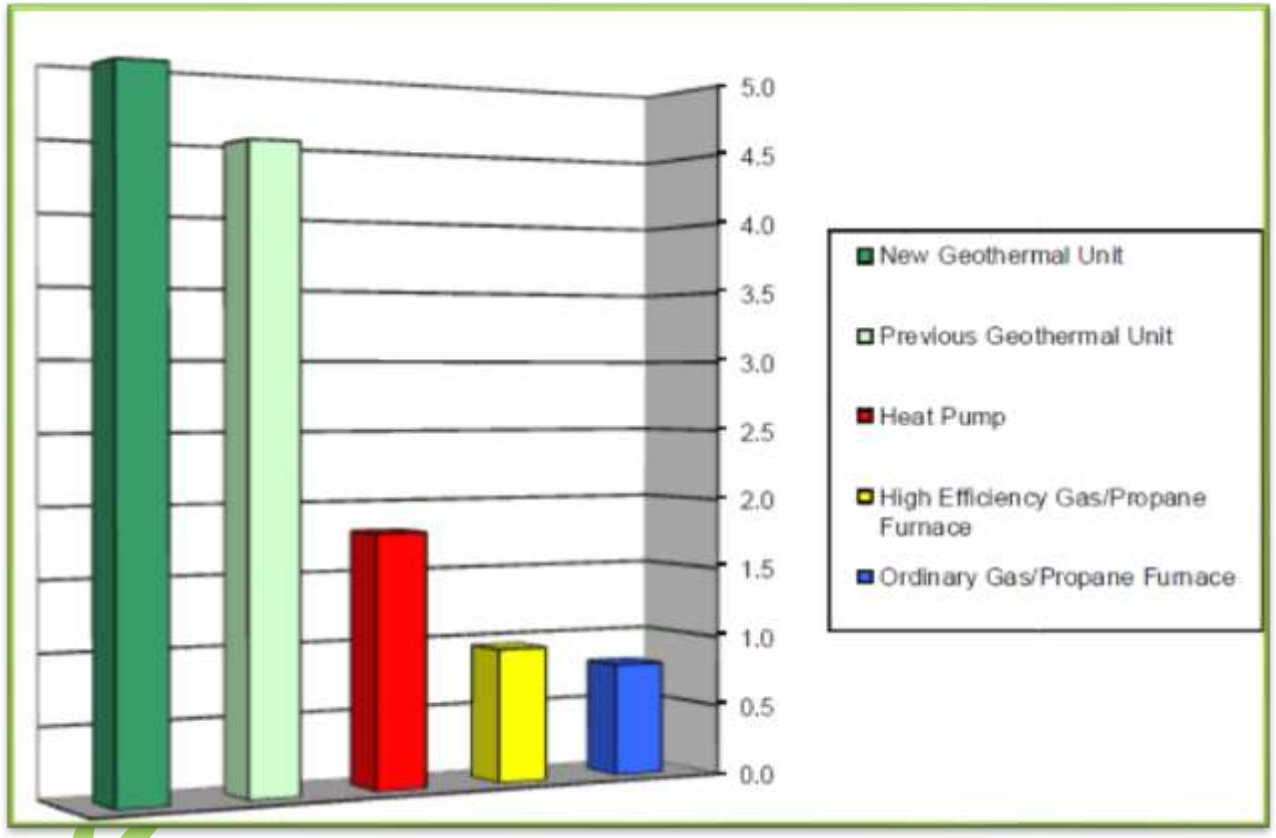
Geothermal Heat Pumps use only a small amount of energy to capture a large amount of FREE energy from the earth.

Energy Efficiency Ratio (EER)

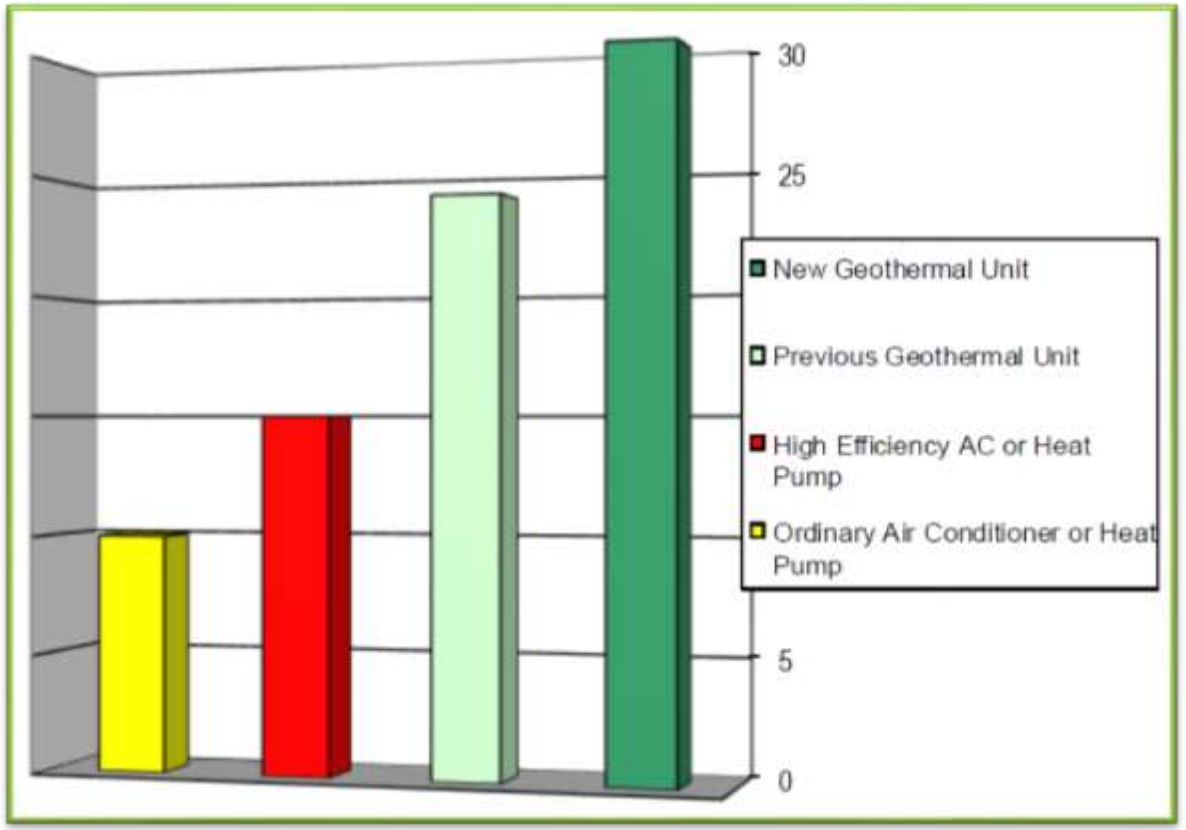
- EER = BTU output divided by power watt input
- For cooling operation under steady state test conditions

Coefficient of Performance (COP)

- COP = BTU output divided by BTU input
- For heating operation under steady state test conditions



Heating Efficiency (COP)



Cooling Efficiency (EER)

Loop Types

Open Loop system

- Can be cheaper initial install cost
- If walls is fails no heating or cooling
- Not allowed in some local areas
- High maintenance
- Loop Types Uses existing well

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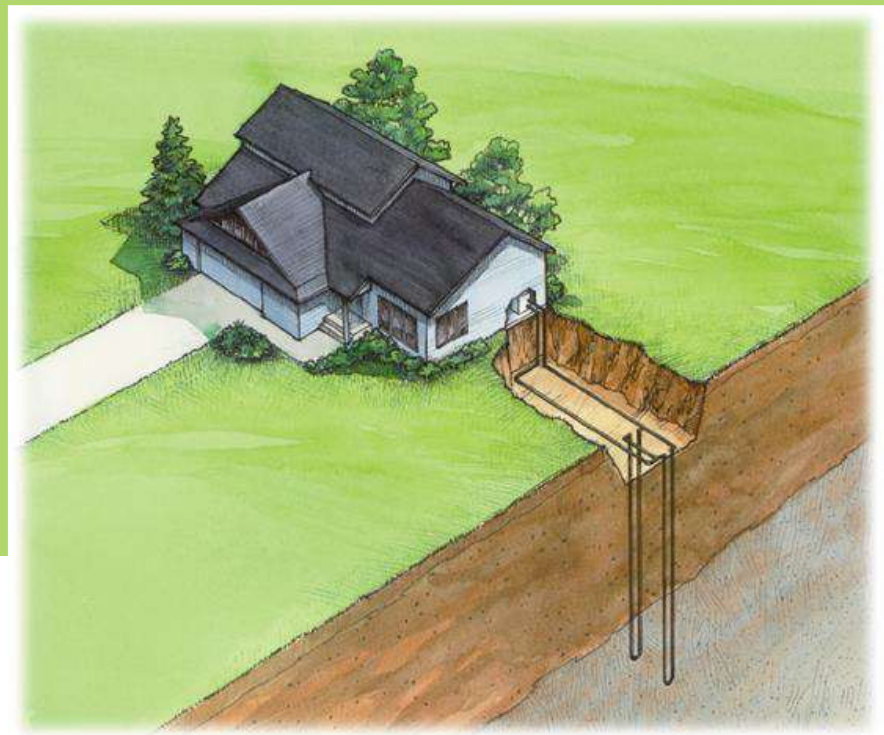
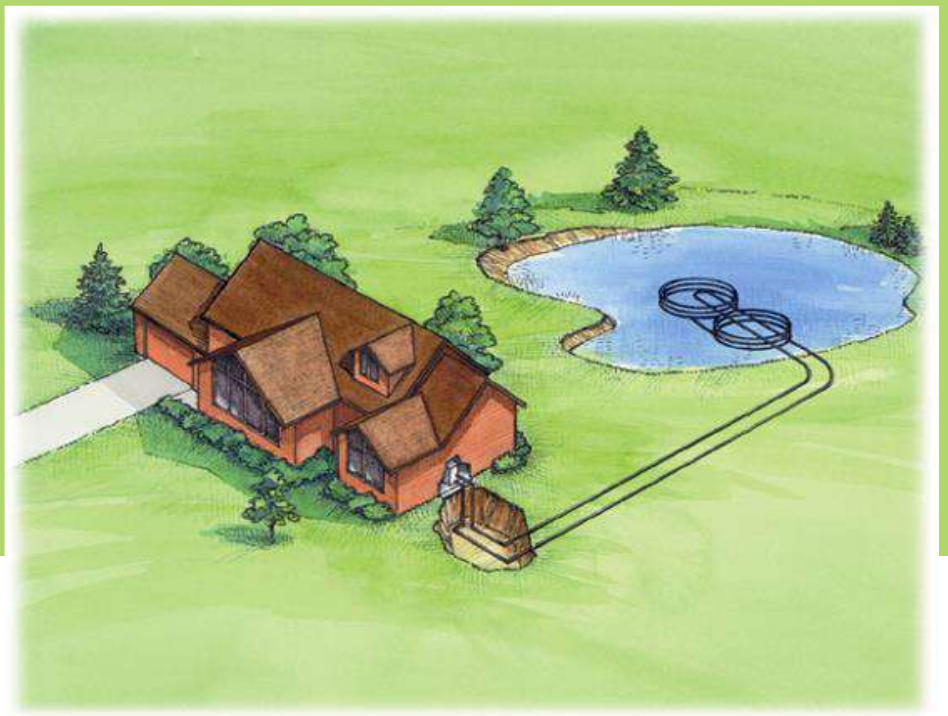
Closed loop systems



Vertical loop



Pond Loop

- Low maintenance
- Typical one time install, long warranty on pipe
- Higher up front installation cost
- Requires dedicates space for wells or trenches

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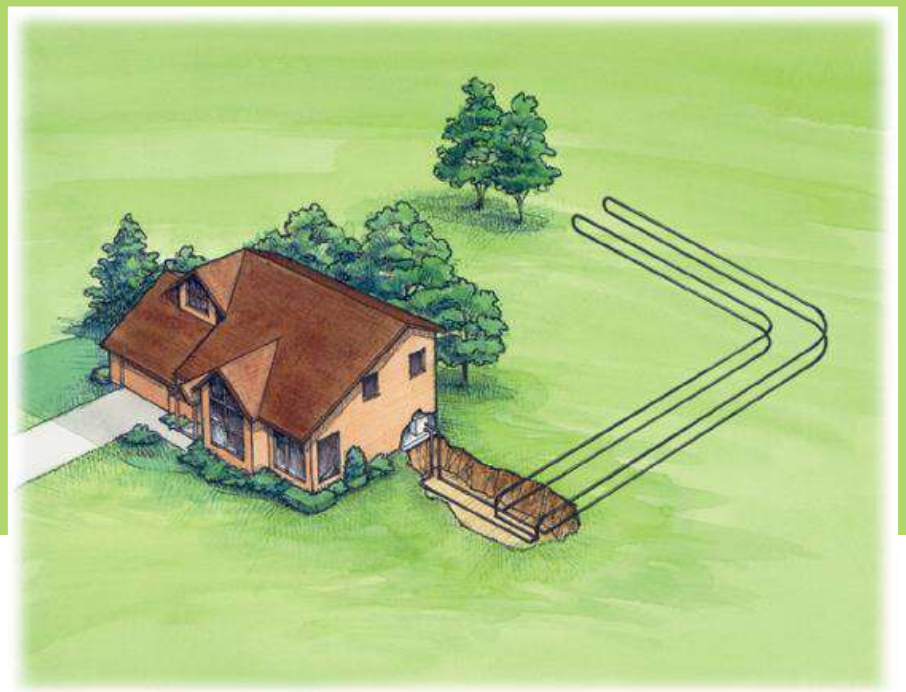
Closed loop systems



Horizantal loop

If adequate soil or clay based land is available & it's more economical choice

•A typical horizontal loop will have 400-600 feet of pipe for heating & cooling

•Because of the amount trenching involved horizontal ground loops are most commonly used for new construction

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Construction of project

A

Preparation heat system

B

Preparation heat system

C

Preparation heat system

D

Heat well

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Construction of project

A

Preparation heat system

B

Preparation heat system

C

Preparation heat system

D

Heat well

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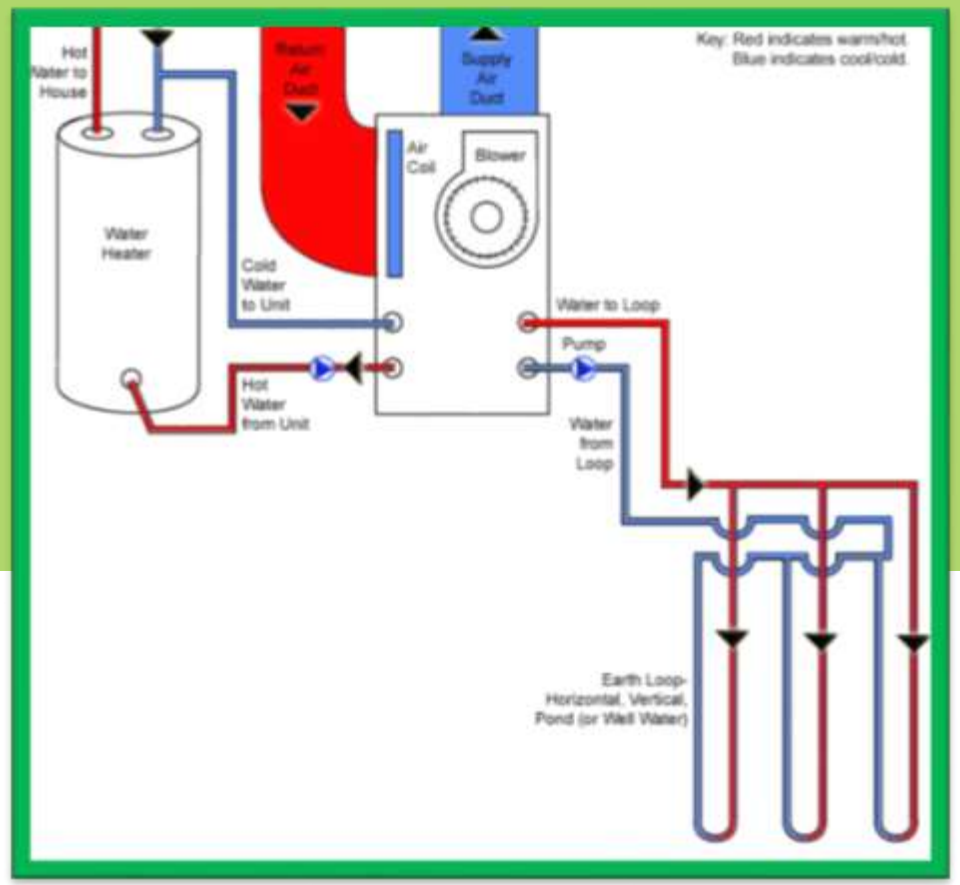
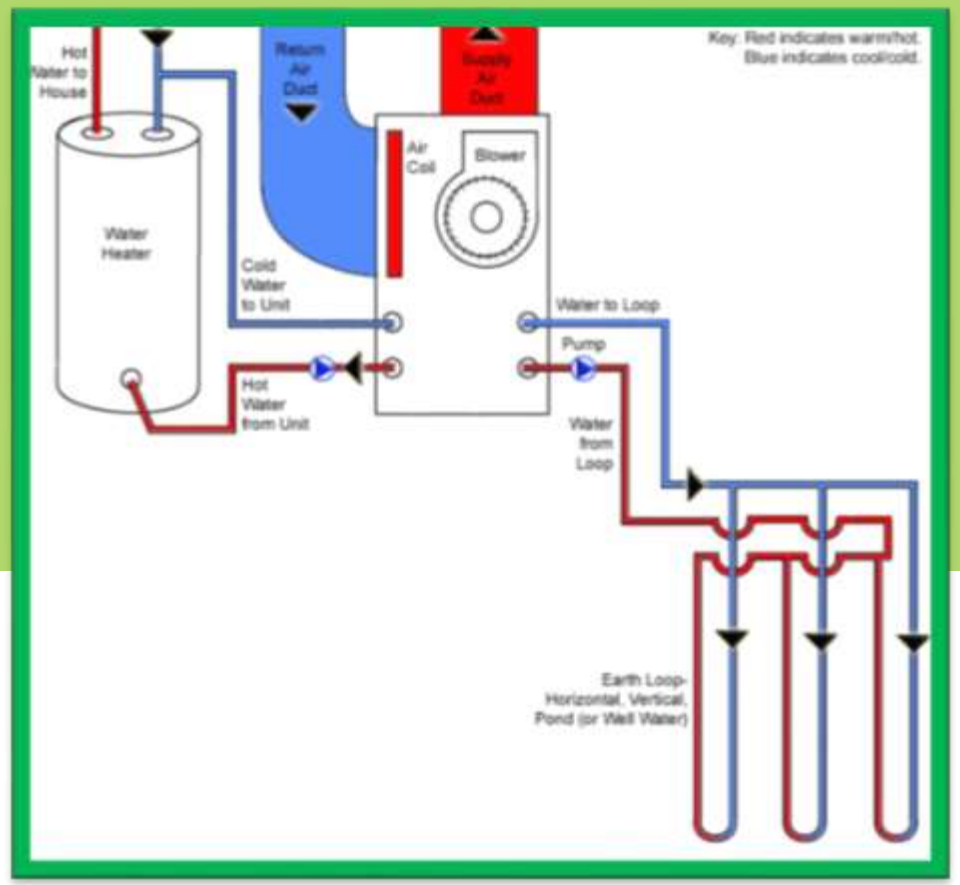
Mode Operation



Cooling Mode Operation



Heating Mode Operation

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Advantages

- ✓ Geothermal system are able to transfer heat to the ground with minimum use of electricity
- ✓ Geothermal system are environment friendly
- ✓ Based on renewable energy source
- ✓ Don’t use fuel for heating & cooling purpose
- ✓ Geothermal system are more reliable and efficient compare to the conventional system
- ✓ Operating and maintenance cost is so low
- ✓ It’s least polluting compared to the other conventional energy sources
- ✓ Once we built a geothermal power station then the energy is almost free
- ✓ Geothermal heat pump are especially well matched to under floor heating system which don’t require extremely high temp.
- ✓ With use of geothermal system it’s consumption level of electricity is so low compared to the conventional system
- ✓ No sticky feeling
- ✓ Additional cost of geothermal system is usually recovered in about 5 years.

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Disadvantages

- ✓ Largest areas are needed for exploitation of geo-thermal energy as much of it's diffused
- ✓ Installation cost is so high
- ✓ Once we built geothermal loop system then we don't change it
- ✓ Required hot rock of a suitable type at a depth where we can drill down to them
- ✓ Hazardous gases & minerals may come up from underground and can be difficult to safely dispose of
- ✓ Largest amount of work's are required

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