

Basic Renewable Energy



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Presentation Outline



What is Renewable Energy?



RE Resources and Technologies



Renewable Energy Act of 2008



Way Forward



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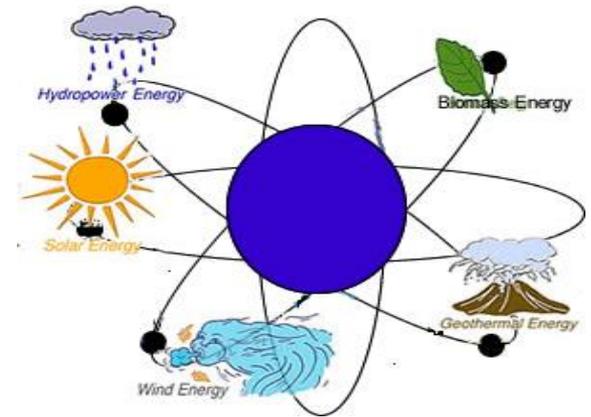


Way Forward

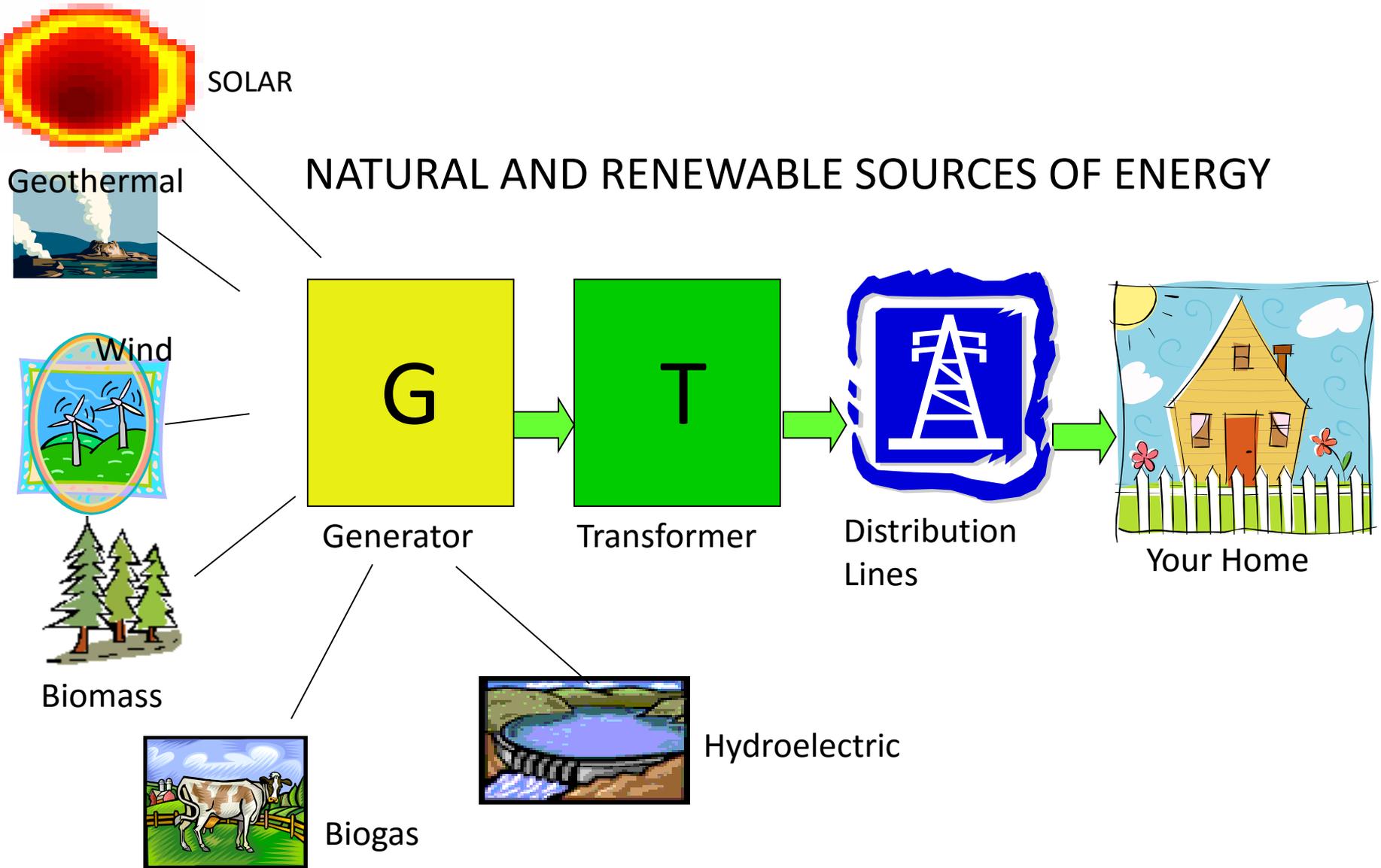


What is Renewable Energy?

- Renewable energy is sustainable as it is obtained from sources that are inexhaustible (unlike fossil fuels).
- Renewable energy sources include wind, solar, biomass, geothermal and hydro, all of which occur naturally on our planet.
- It is clean energy and non-polluting.
- Many forms do not emit any greenhouse gases or toxic waste in the process of producing electricity.
- It is a sustainable energy source which can be relied on for the long-term. Renewable energy is cost-effective and efficient.



What is Renewable Energy?



What is Renewable Energy?

Renewable Energy Potential



Geothermal > 4,000 MW

Wind resource > 76,600 MW

Hydropower > 10,000 MW

Solar > 5 kWh/m²/day

Ocean > 170,000 MW

Biomass > 500 MW (*bagasse & rice hulls only*)

- Largest producer of coconut oil
- Ranks 10th in world sugarcane production



Renewable Energy Development



- **B**iomass / **B**iofuels
- **G**eothermal
- **S**olar Power
- **H**ydropower
- **O**cean
- **W**ind Power



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Biomass Energy System

Any organic matter (excluding fossil fuels), that was or is a living organism and can potentially be used as fuel.

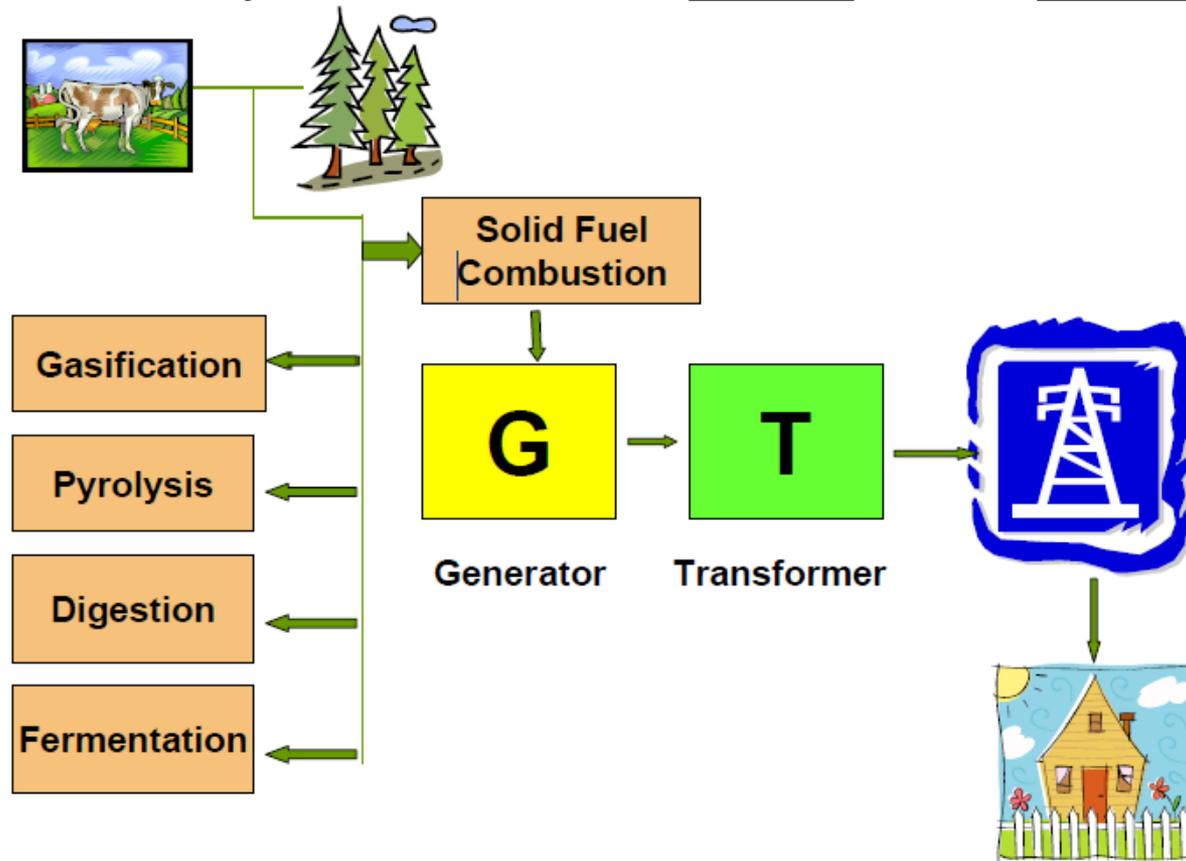
Comprised of fuelwood, charcoal, bagasse, ricehull, animal waste and other agriwaste.



Biomass Energy System

How Biomass energy system works

Gasification, pyrolysis, digestion, fermentation and solid fuel combustion are five different processes that use the biomass to make electricity.



Biomass Energy System

How Biomass energy system works

Direct Combustion Systems - involves direct burning of organic materials to produce either process heat or power.

Examples:

- Biomass Cookstoves
- Biomass-fired Furnace, Kilns and Ovens
- Biomass-fired Boilers



Biomass Energy System

How Biomass energy system works

GASIFICATION - combustion of dry organic matter producing heating value gaseous fuel (i.e., **producer gas**) to either produce shaft power. The system is called "**Gasifier**".

Applications:

- Dryers
- Boilers
- Internal Combustion Engines
- Gas turbines



Biomass Energy System

How Biomass energy system works

Pyrolysis - destructive distillation of biomass by the action of heat in the absence of oxygen to produce charcoal, low heating value oils and gases. The system is called “Pyrolytic Converter”.



Biomass Energy System

How Biomass energy system works

Anaerobic Fermentation - bacterial decomposition of organic matter in the absence of air (i.e., anaerobic) to produce **biogas**, a low heating-value gas which is 50% to 60% methane by composition. The system is often called “**Biogas Digester**”.

Common biogas feedstocks:

- Animal Wastes (hog and chicken manure, etc.)
- Industrial Wastes (e.g., distillery wastes)
- Other organic wastes
- (waste from slaughterhouses)



Geothermal Energy

WHAT DOES THE WORD "GEOHERMAL" MEAN?

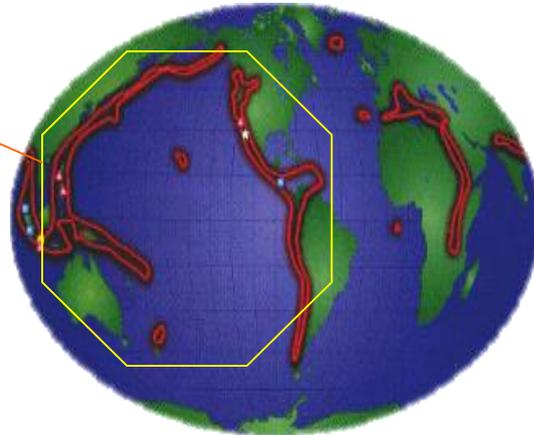
Geo = Earth Thermal = Heat

WHAT IS GEOTHERMAL ENERGY?

Energy that can be extracted from the heat in the earth

Conditions are most favorable for geothermal activity where the earth's tectonic plates collide and one slides beneath another. The best example of these hot regions is the Pacific Ring of Fire

**Pacific Ring
of fire**

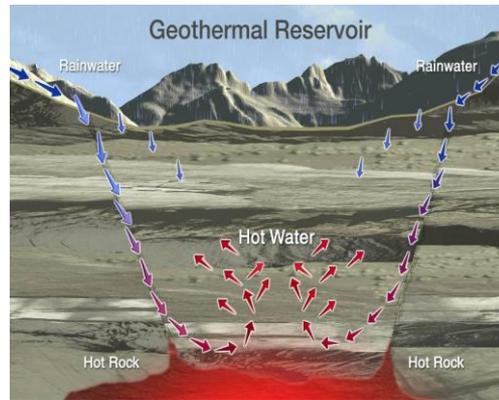


Geothermal Energy

HOW DOES GEOTHERMAL HEAT GET UP TO EARTH'S SURFACE?

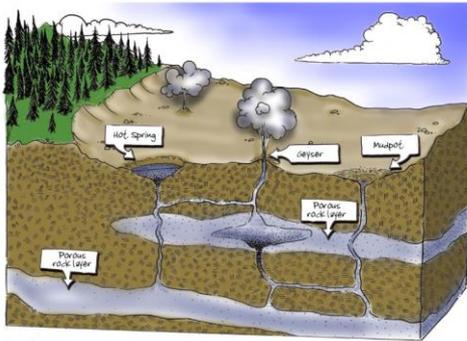
➤ Conduction

Heat from the Earth's interior flows outward. It is transferred to the outer layer of rock or the crust.



➤ Convection

In some regions, the mantle beneath the crust may be hot enough to partly melt and create magma. Magma rising upward out of the mantle can bring intense shallow heat into the crust

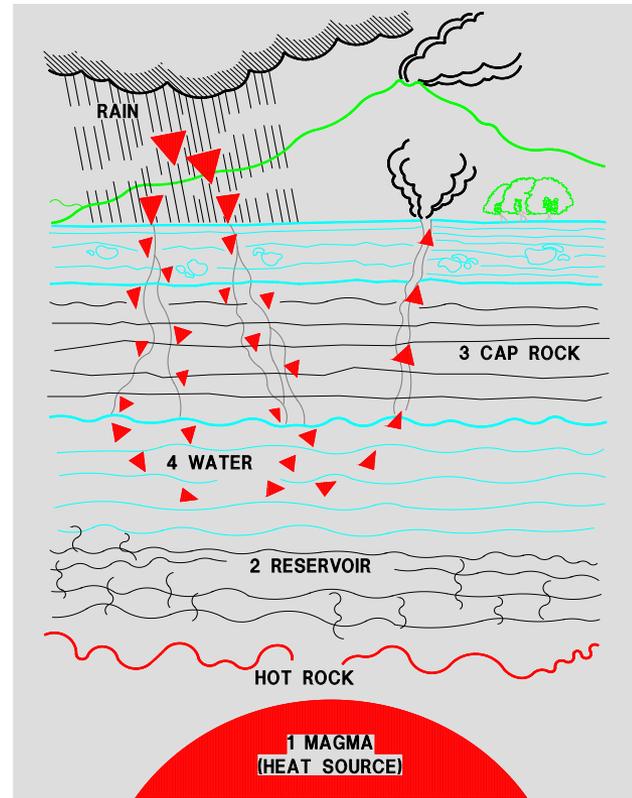
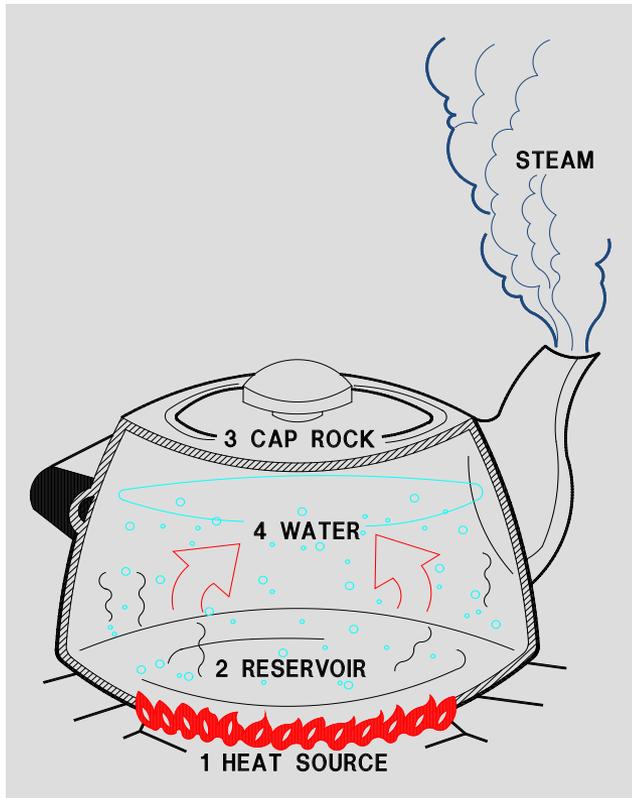


Rainwater seeping downward through pores and crevices in the crust to depths of a mile or more is heated. The heated water may be stored at depth in geothermal reservoirs, or the hot water may flow upward out the reservoirs to the surface as hot springs, or boil near the surface to create geysers, fumeroles, and mudpots.



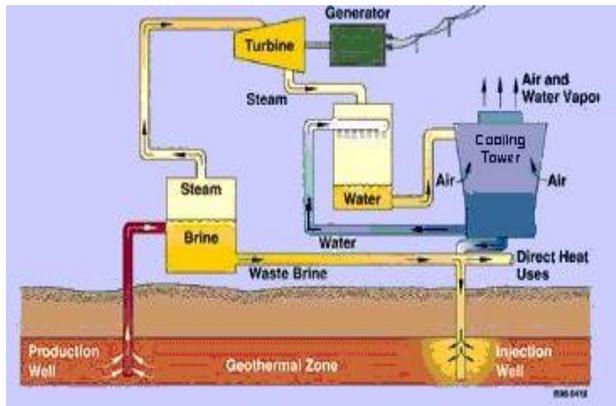
Geothermal Energy

Geothermal Energy...the kettle concept



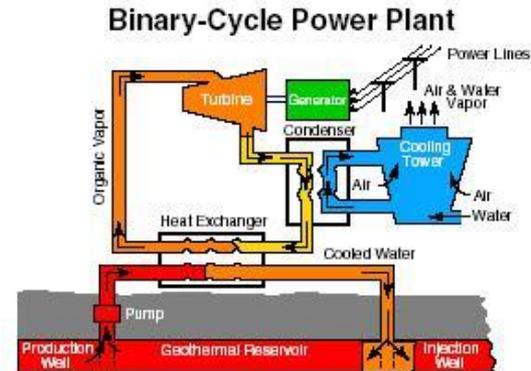
Geothermal Energy

HOW IS ELECTRICITY GENERATED USING GEOTHERMAL ENERGY?

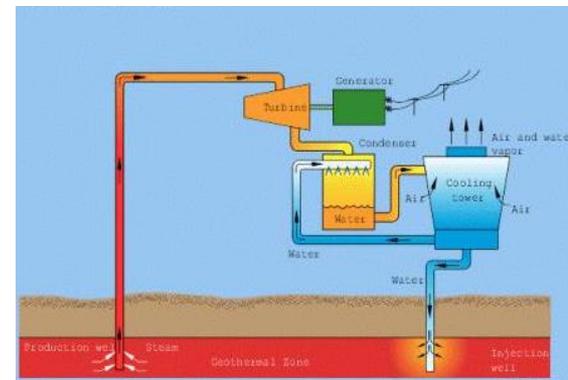


The geothermal fluids are brought to the surface through wells that are drilled deep into the earth. The hot water (300°F or more) is highly pressurized. As the water pressure is reduced during transit to the surface, 30 – 40% of the water flashes (explosively boils) to steam. The steam is fed to a turbine/generator to produce electricity. The remaining water is returned into the earth to help maintain pressure and prolong the productivity of the geothermal well.

A few geothermal reservoirs produce mostly steam and very little water. The steam shoots directly through a rock-catcher and into the turbine.

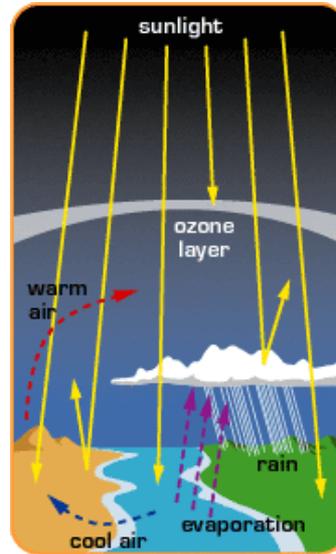
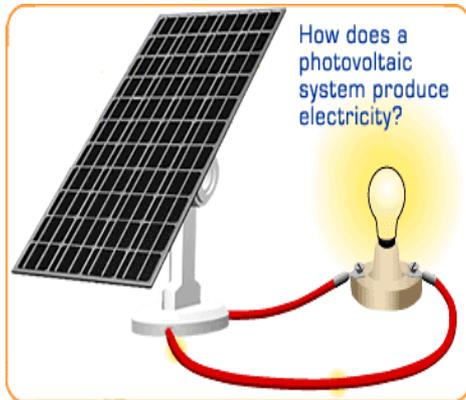


Geothermal water is passed through a heat exchanger to heat a secondary fluid that vaporizes at a lower temperature than water. The fluid vapor spins the turbine/generator, is condensed back to liquid and re-vaporized at the heat exchanger.



What is Solar Energy?

Solar energy is the energy that comes from the sun that supports life on earth as we know it.



Solar energy can be used as a source of heat and light and can be used to generate electricity.

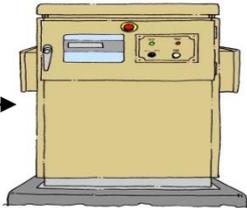
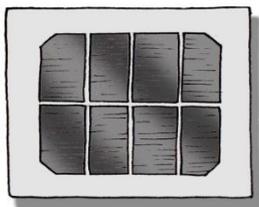


What is Solar Energy?

HOW A PHOTOVOLTAIC SOLAR SYSTEM WORKS



The sun illuminates the solar cells in the PV Array, which convert the energy in the sunlight into electricity. The electricity goes into an inverter and into the power lines to your home.



PV Array

Inverter

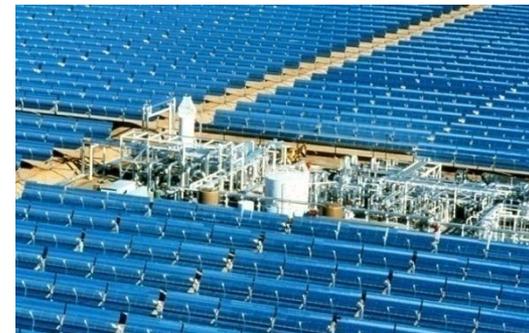
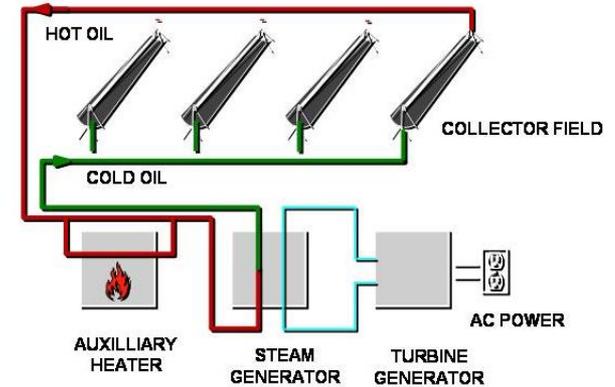


What is Solar Energy?

HOW A SOLAR THERMAL POWER PLANT WORKS

- *Parabolic (trough) mirrors can focus the sun at 30 to 60 times its normal intensity on a receiver pipe located along the focal line of the trough.*
- *Synthetic oil captures this heat as it circulates through the pipe, reaching temperatures as high as 750°F. The hot oil is pumped through a heat exchanger on the power production side of the plant to produce steam.*
- *Electricity is produced in a conventional steam turbine/generator*
- *The power cycle is completed with the condensing of the steam through a cooling tower and then pumping it back through the heat exchanger connected to the solar energy collection field.*

Parabolic Trough Solar Power Plant



What is Hydropower?

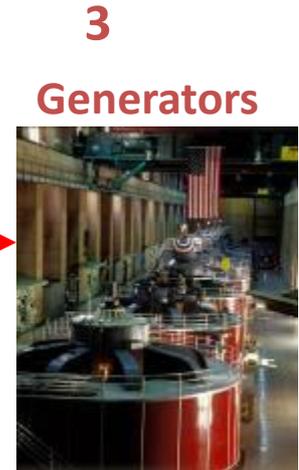


Hydro means water in Latin. It is the most often used source of renewable energy used to make electricity.



How a Hydropower Plant Works?

Water goes to



4
Electric Grid



- 1. Water goes into the Penstock Pipe at high speed through the Intake Towers**
- 2. And then goes to a Turbine Wheel**
- 3. The Turbine Wheel spins the rotor of the Generator and makes AC electricity,**
- 4. The electricity goes to the electrical grid to be used in your home, in stores and in manufacturing plants.**



What is Wind Energy?

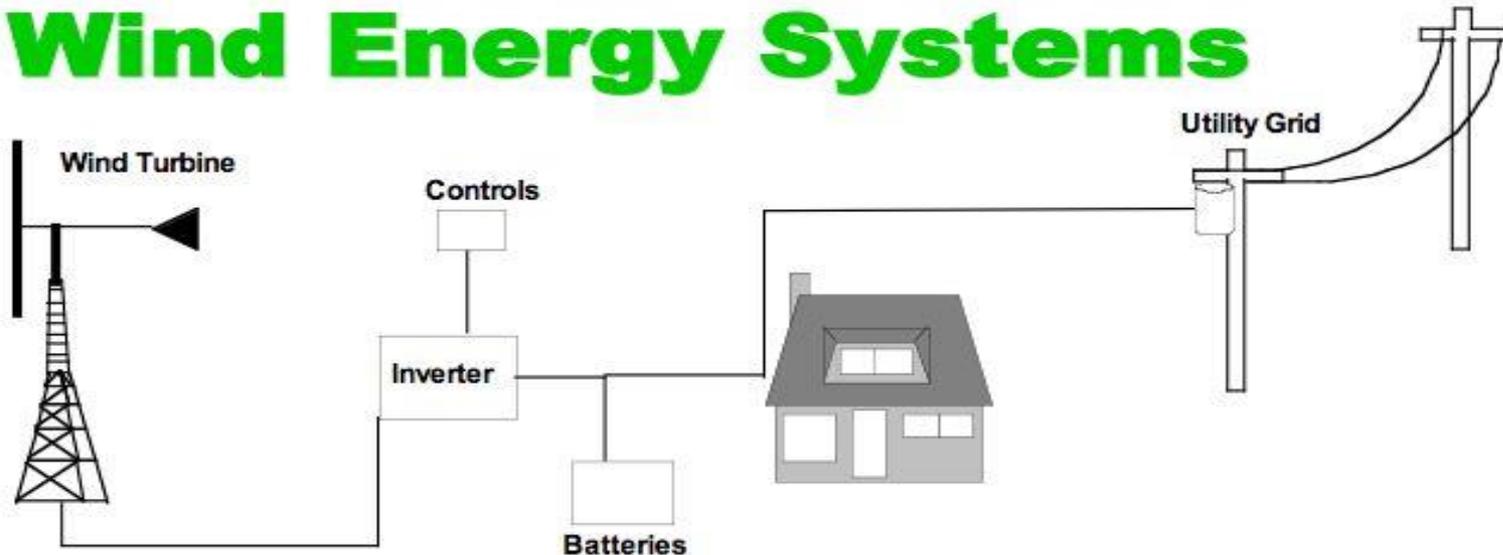
- ***Wind Energy is the energy contained in the force of the winds blowing across the earth's surface.***
- ***Wind is created when air that has been warmed over sun-heated land rises, leaving a vacuum in the space it once occupied.***
- ***Cooler surrounding air then rushes in to fill the vacuum. This movement of rushing air is what we know as wind.***



How Wind Energy Works?

Wind Energy provides the energy that enables the wind turbine to produce DC current that could be used to run a machine. Often an inverter is installed to convert the DC current to AC current that is used in homes. In addition, a battery system can be installed to provide backup power when is not adequate enough to generate power.

Wind Energy Systems



Presentation Outline



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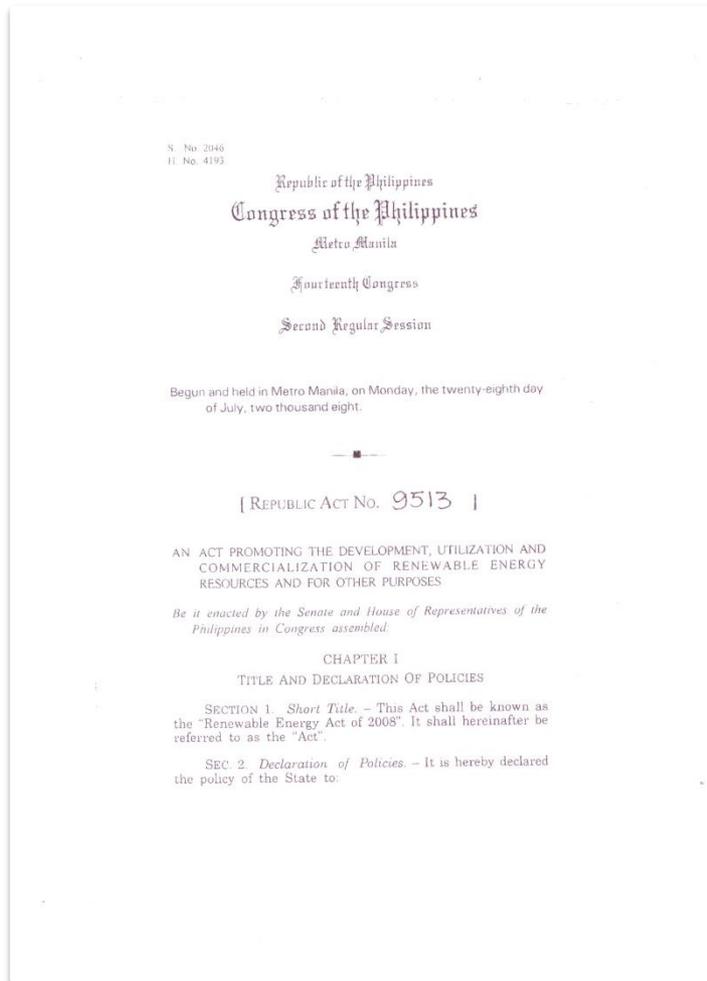
Renewable Energy Act of 2008



Way Forward



RA No. 9513: The RE Act of 2008



An Act Promoting the Development, Utilization, and Commercialization of Renewable Energy Resources and for Other Purposes

Signed: 16 December 2008

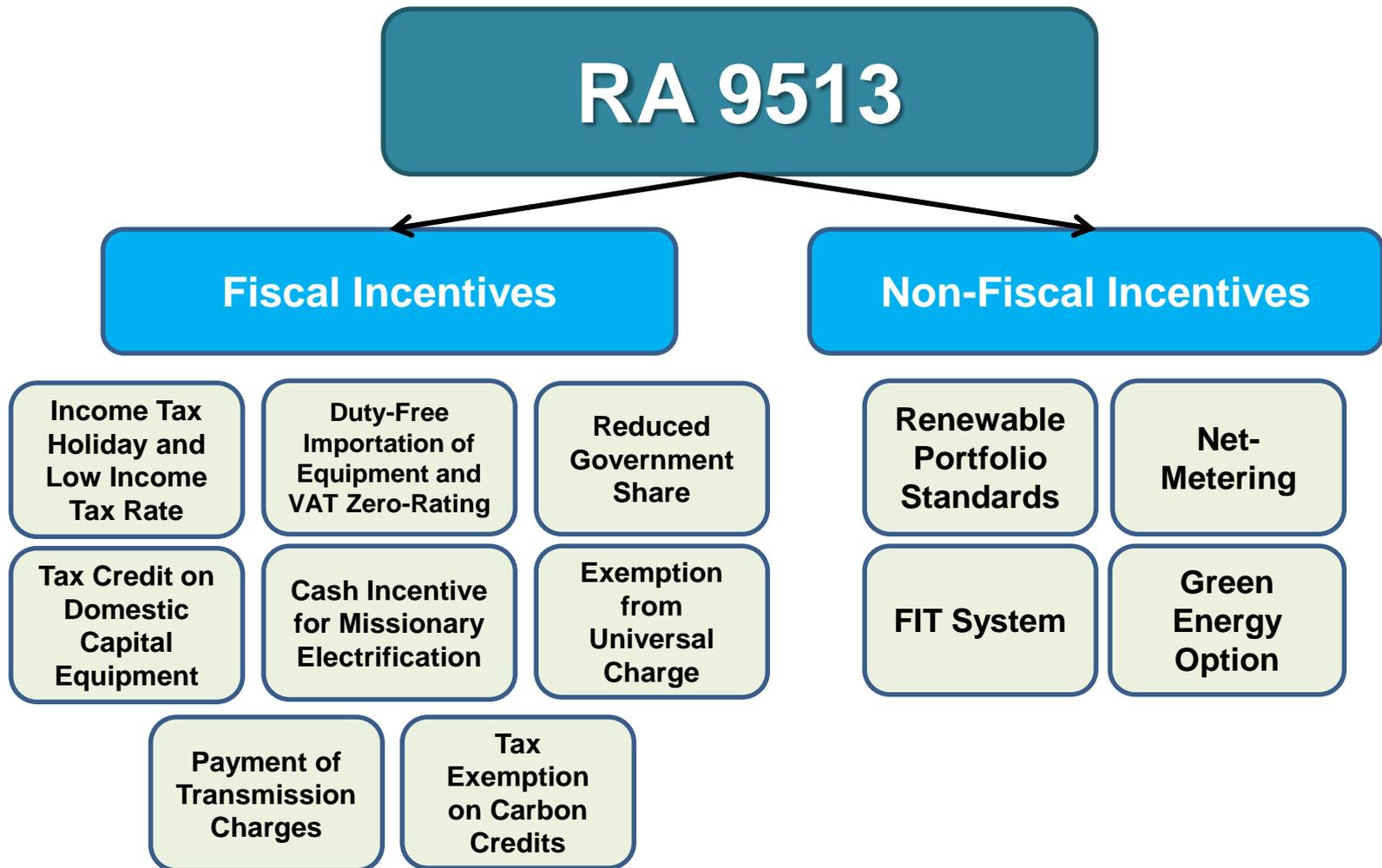


Declared Policies of the State

- Accelerate the exploration and development of renewable energy resources
 - Achieve energy self-reliance
 - To reduce the country's dependence on fossil fuels
 - Minimize the country's exposure to price fluctuations
 - Adoption of clean energy to mitigate climate change
 - Promote socio-economic development in rural areas
- Increase the utilization of renewable energy by providing fiscal and non-fiscal incentives;



Incentives under the RE Act



Awarded RE Projects Under RE Law

SUMMARY OF AWARDED RE PROJECTS (as of March 15, 2018)

RESOURCES	AWARDED PROJECTS		POTENTIAL CAPACITY MW		INSTALLED CAPACITY MW	
	Grid-Use	Own-Use	Grid-Use	Own-Use	Grid-Use	Own-Use
Hydro Power	455		13,445.16		975.79*	
Ocean Energy	7		26			
Geothermal	40		555		1,906.19*	
Wind	64	1	2,381.50		426.9	0.006
Solar	216	16	6,512.12	4.286	925.34	3.218
Biomass	57	24	334.17	16.77	449.01	128.16
Sub-Total	839	41	23,260.17	21.056	4,683.23	131.38
TOTAL	880		23,281.23		4,814.61	

NOTE:

* - excluding 49 installed projects with 2,643.68MW capacity under RA 7156, CA 120, PD 1645, RA 3601 & Own-Use

** - excluding 1 potential project with 20MW capacity under PD 1442.



Awarded RE Projects Under RE Law (Visayas)

SUMMARY OF AWARDED RE PROJECTS IN VISAYAS (as of March 15, 2018)

RESOURCES	AWARDED PROJECTS		POTENTIAL CAPACITY MW		INSTALLED CAPACITY MW	
	Grid-Use	Own-Use	Grid-Use	Own-Use	Grid-Use	Own-Use
Hydro Power	50		906.60		13.31	
Ocean Energy	4		10			
Geothermal	9		110		945.18	
Wind	21		1,001.55		90	
Solar	41	4	1,151.58	3.21	504.97	0.096
Biomass	14	11	136	0.62	196.08	73.71
Sub-Total	139	15	3,315.73	3.83	1,749.54	73.806
TOTAL	154		3,319.56		1,823.35	



RE Capacity Additions under RA 9513

From 2009 – December 2017

RESOURCES	2009	2010	2011	2012	2013	2014	2015	2016	2017	Own-Use	Net Metering	Total
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
Biomass	37.33	35.90	19.00	19.00	0.876	12.00	124.50	40.80	17.14	128.16		434.71
Geothermal	-	-	-	-	-	50.00	10.00			-		60.00
Solar	-	-	-	-	-	22.00	141.77	728.58	-	3.22	8.163	903.73
Hydro Power	-	2.00	2.10	11.80		16.65	14.82	10.00	8.50	-		65.87
Ocean Energy	-	-	-	-	-	-				-		-
Wind	-	-	-	-	-	303.90	90.00			0.006		393.91
TOTAL	37.33	37.90	21.10	30.80	0.88	404.55	381.09	779.38	25.64	131.38	8.16	1,858.20



Renewable Energy Green Jobs

2009-2017	BIOMASS	SOLAR	WIND	HYDROPOWER	GEOTHERMAL	TOTAL
Additional Capacity	306.55	892.35	393.9	65.87	60.00	
Construction Jobs	12,875	80,312	35,451	4,051	720	133,409
O & M Jobs	1,379	1,606	1,773	474	306	5,539
TOTAL	14,255	81,918	37,224	4,525	1,026	138,947

**138,947 Green Jobs
Generated (2009-2017)**



Renewable Energy Cost of Investments

2009-2017	BIOMASS (Million PhP)	SOLAR (Million PhP)	WIND (Million PhP)	HYDROPOWER (Million PhP)	GEOHERMAL (Million PhP)	TOTAL (Million PhP)
Additional Capacity	306.55	892.35	393.9	65.87	60.00	
Cost of Investment	30,655	84,773	37,421	1,976	12,000	166,825

Note:

Investment cost is computed based on the minimum investment per megawatt under Development Stage pursuant to DO2013-10-0018.

**PhP166,825 Million
Cost of Investments**



The Way Forward

- ❑ Promulgate Implementing Rules on remaining RE Policy Mechanisms (Renewable Portfolio Standard (RPS) Off-grid, Green Energy Option, REM Rules)
- ❑ National Renewable Energy Program (NREP)
- ❑ Capacity Building / Information, Education and Communication Campaigns
 - Roll-out Programs on RPS
 - Trainor's training
 - Hands-on Training



Thank You!

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