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AGRICULTURAL STRUCTURES AND ENVIRONMENTAL CONTROL BTAP3105

SEWAGE SYSTEM

SUDIPTA BEHERA
ASSISTANT PROFESOR, SoABE



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SEWAGE SYSTEM DESIGN, SEPTIC TANK DESIGN, ESTIMATION OF DOMESTIC POWER REQUIREMENT, SOURCE OF POWER SUPPLY & ELECTRIFICATION OF RURAL HOUSING.



Introduction

sewage

- Sewage is wastewater from domestic activities such as cooking, cleaning, laundry or bathing

Sewage treatment

- **Sewage treatment** is the process of removing contaminants from wastewater primarily from household sewage. It includes physical, chemical, and biological processes to remove these contaminants and produce environmentally safe treated wastewater (or treated effluent).

Residual

- Residual of Sewage treatment is semi-solid waste or slurry, needs to be retreated before disposed off or land application.

Importance of Sewage system

Exposure to sewage through ingestion or bodily contact can result in disease, severe illness, and in some instances death from the bacteria, viruses and parasites contained in the waste. Therefore, it is important for sewage to be properly treated.

To reduce pollution and maintain good environment

This modern water carriage sewerage system not only helps in removing the domestic and industrial waste water, but also helps in removing storm water drainage. The runoff resulting from the storms is also sometimes. Sewage system has been divided into three category.

3.1 Domestic Sewage

3.2 Industrial Sewage

3.3 Storm Sewage

3.1 Domestic Sewage:

The wastewater from residences and institutions, carrying body wastes primarily feces and urine, washing water, food preparation wastes, laundry wastes, and other waste products of normal living, are classed as domestic or sanitary sewage.

3.2 Industrial Sewage:

Liquid-carried wastes from stores and service establishments serving the immediate community, termed commercial wastes, are included in the sanitary or domestic sewage category if their characteristics are similar to household flows. Wastes that result from an industrial processes such as the production or manufacture of goods are classed as industrial wastewater, not as sewage.

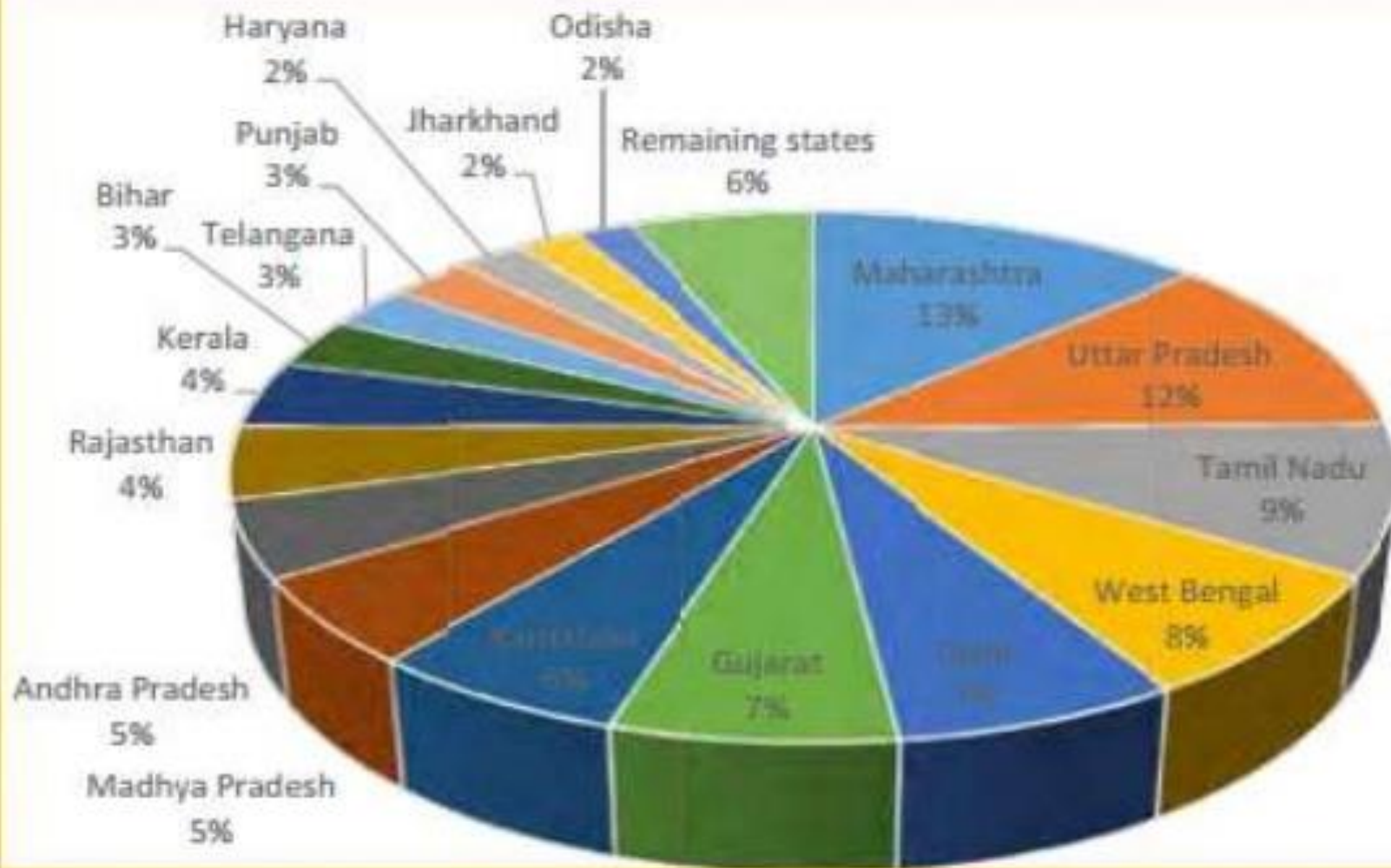
3.3 Storm Sewage:

Surface runoff, also known as storm flow or overland flow, is that portion of precipitation that runs rapidly over the ground surface to a defined channel. Precipitation absorbs gases and particulates from the atmosphere, dissolves and leaches materials from vegetation and soil, suspends matter from the land, washes spills and debris from urban streets and highways, and carries all these pollutants as wastes in its flow to a collection point.

Effects due to improper system

- In many developing countries the bulk of domestic and industrial wastewater is discharged without any treatment or after primary treatment only
- Overall ecology or environment get effected by way of:
 - 1) Increase impurity of water, both surface and ground water
 - 2) Oil, Grease and lighter solid floats, blocks exchange of oxygen and affects evaporation process
 - 3) Residual Chlorine affects aquatic life
 - 4) Increase level of bacteria, viruses, and other pathogens in water body creates more infections.

State wise percentage generation of sewage



Sources of Waste water

House hold Effluent

- Household waste liquid from toilets, baths, showers, kitchens and sinks

Industrial Effluent

- Industrial process waste including toxic chemical contents

Urban runoff (Storm water)

- As rainfall travels over roofs and the ground, it may pick up various contaminants including soil particles and other sediment, heavy metals, organic compounds, animal waste, and oil and grease.

IMPORTANCE OF SEWAGE WATER TREATMENT PLANT:-

- It is very important **to provide some degree of treatment to wastewater before it can be used** for agricultural or landscape irrigation or for aquaculture.
- The principal objective of sewage treatment is generally to **allow human effluents to be disposed of without danger to human health** or unacceptable damage to the natural environment.
- According to a research, a **large number of people die** from water born diseases in most of the developing countries. Therefore, it is very important to get the proper treatment of the water for a healthy living.

WASTE WATER TREATMENT PROCEDURE

Sewage treatment generally involves three stages, called

- ❑ **PRIMARY TREATMENT**
- ❑ **SECONDARY TREATMENT**
- ❑ **TERTIARY TREATMENT**

TYPES OF THE TREATMENT PROCESS

Sr. No.	Type of treatment	Type of treatment unit	Name of the unit	Type of impurities removed
1.	Physical treatment	Physical	Screen	Large suspended and floating matter
		Physical	Grit chamber	Grit
		Physical	Clarifiers	Silt, sand and other heavier matter
2.	Chemical treatment	Chemical	Chemical reactors	Dissolved chemicals
3.	Biological treatment	Biological	-Trickling filters -Activated sludge Plant -Rotating biological contactors - Digesters	Dissolved organic chemicals

Homes and Businesses produce wastewater

Pump lifts wastewater

Bar Screen removes large debris like branches

Sedimentation Tank solids settle to the bottom as sludge and scum floats to the top

Secondary Aeration provides oxygen for microorganisms

Sludge Digester reduces volume and odors and destroys harmful organisms

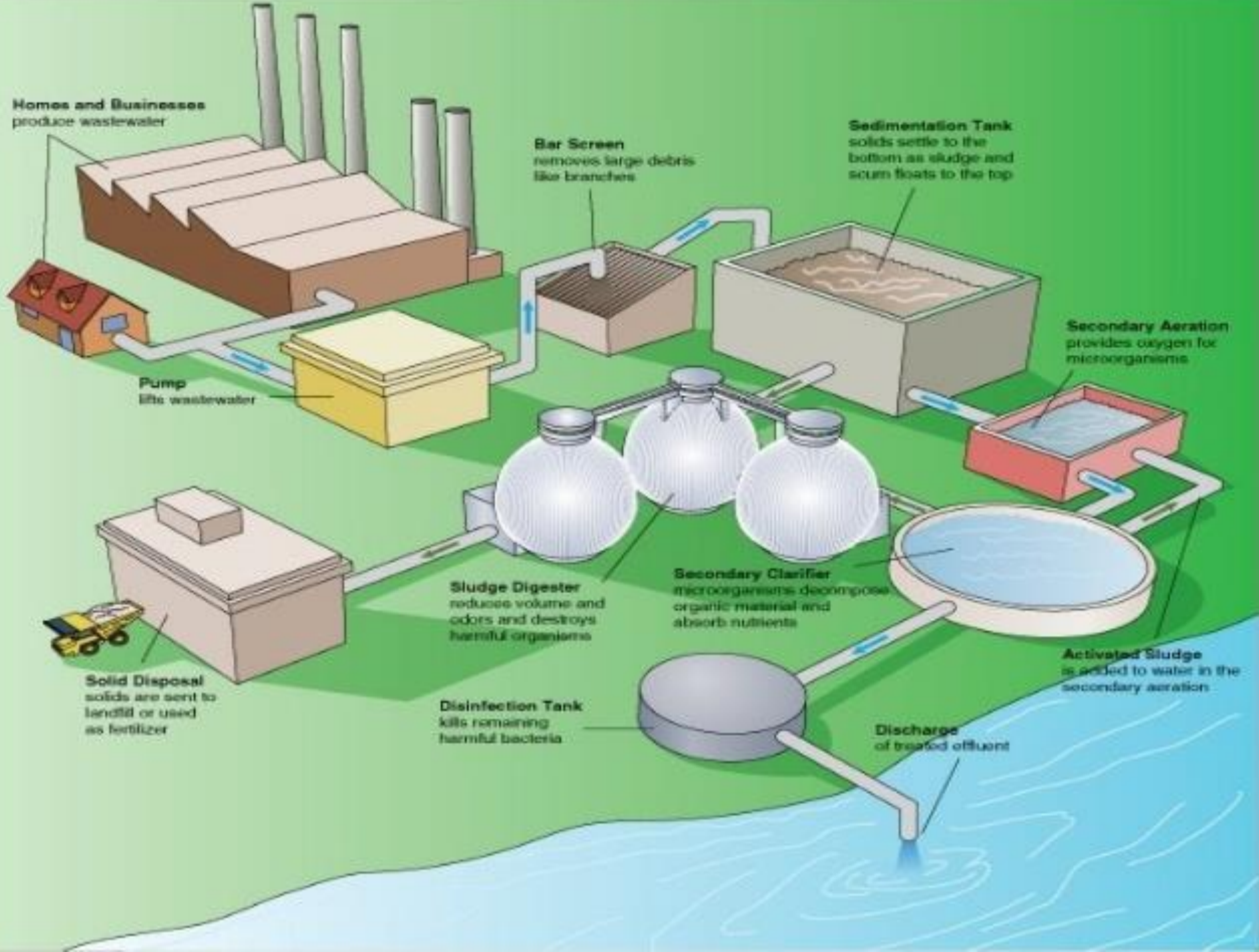
Secondary Clarifier microorganisms decompose organic material and absorb nutrients

Solid Disposal solids are sent to landfill or used as fertilizer

Disinfection Tank kills remaining harmful bacteria

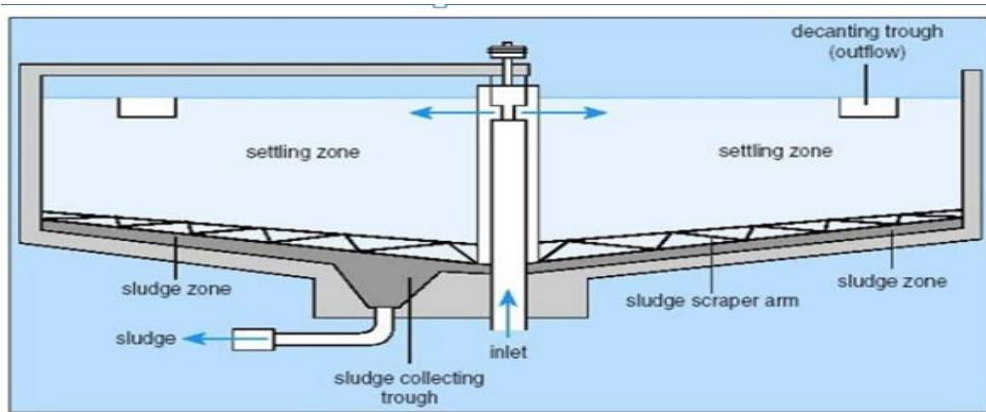
Activated Sludge is added to water in the secondary aeration

Discharge of treated effluent



PRIMARY TREATMENT

- Primary treatment **removes materials** that can be easily collected from the raw sewage before they damage or clog the pumps and sewage lines of primary treatment clarifiers **trash, tree limbs, leaves, branches etc..**
- The **settled and floating materials are removed** and the remaining liquid may be discharged or subjected to secondary treatment.



Primary sedimentation tank for sludge removal

BAR SCREENING

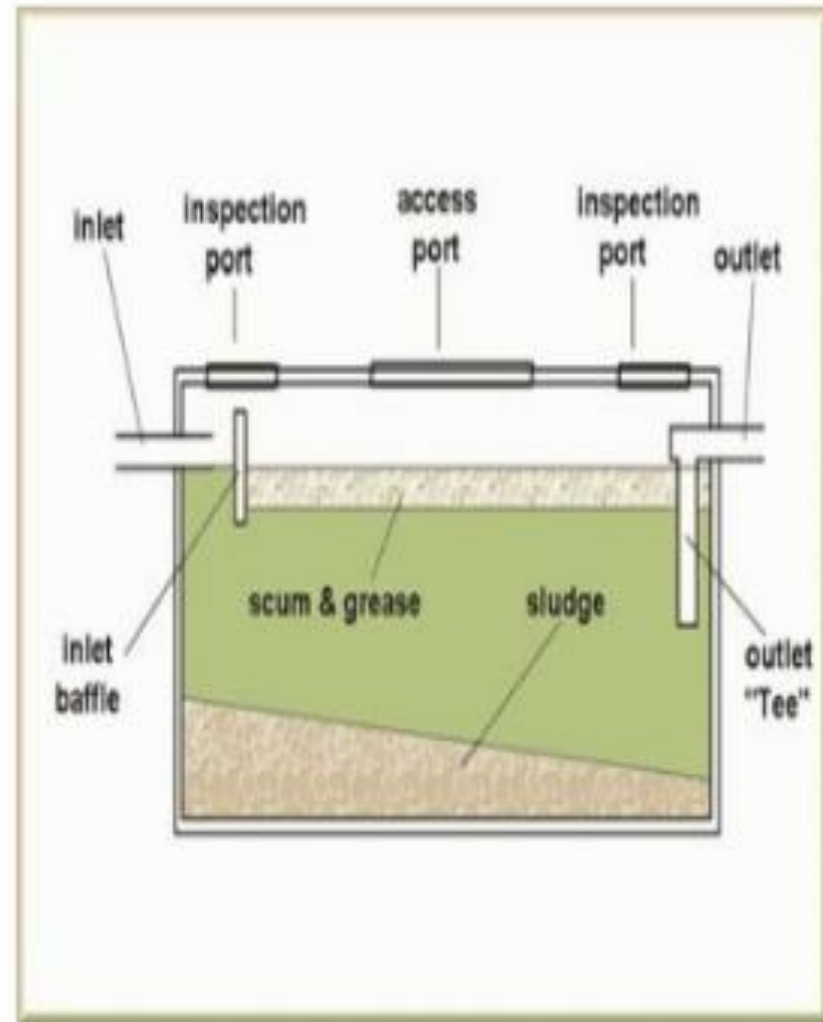
- The influent sewage water passes through a bar screen to remove all large objects like **cans, rags, sticks, plastic packets** etc. carried in the sewage stream. This is most commonly done with an automated mechanically raked bar screen in modern plants serving large populations, whilst in smaller or less modern plants, a manually cleaned screen may be used.



BAR SCREENING

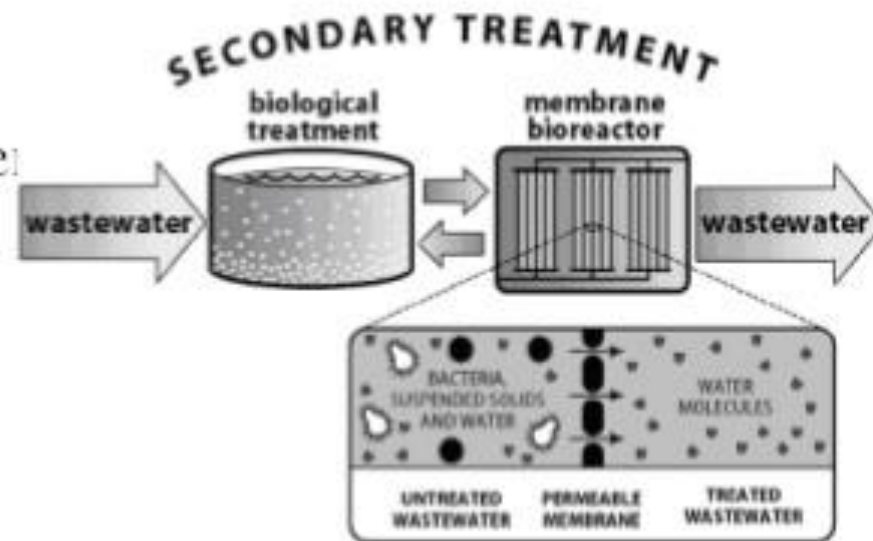
GRIT REMOVAL PROCESS

- Pre-treatment may include a sand or **grit channel** or chamber, where the velocity of the incoming sewage is adjusted to allow the settlement of **sand, grit, stones, and broken glass**. These particles **are removed** because they may **damage pumps and other** equipment.



SECONDARY TREATMENT

- Secondary treatment **removes dissolved and suspended biological matter.** Secondary treatment is typically performed by indigenous, water-borne micro-organisms in a managed habitat.
- Secondary treatment may require a separation process to **remove the micro-organisms** from the treated water prior to discharge or tertiary treatment.



Tertiary Treatment

Removal of residual suspended solids (after secondary treatment), usually by granular medium filtration or micro screens. Disinfection is also typically a part of tertiary treatment. Nutrient removal is often included in this definition

Sewage Treatment Plants Maintenance Services

1. Preventive Electromechanical Maintenance



All operations that are performed to maintain electrical and mechanical equipment to avoid accidents and interruptions reduce repair costs and stop the process.

2. Predictable Electromechanical Support



Design, supply, and installation of electromechanical works for sewage treatment plants. The works include the supply of sewerage pumps, control panels, electrical cables, piping network, and valves.

3. Corrective Electromechanical Maintenance



We offer a complete solution for the sewage treatment plant operation and maintenance. as part of the service and maintenance contracts, a comprehensive and incomplete annual maintenance contract



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What is a septic tank? and why we use it?

The tank which Stores a waste water of House or building is called Septic Tank. Septic Tank is installed where there is no proper drainage system. In order store, the Wastage or sewage for 10-30 Days Septic tank is constructed and the same is designed.

This tank is usually installed below 1.5m-1.8m from ground level. Waste water coming from sewer Pipes of the house are connected to Septic tank.

Wastewater flows into the tank at one end and leaves the tank on the other end as shown in the figure. The septic tank is drained out with the help of suck out the outlet. The municipal Department suck out the wastage from Septic tank.



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All waste water from the bath, toilet, kitchen flows into the tank. Heavy Solids in waste water is settled at bottom of the tank.

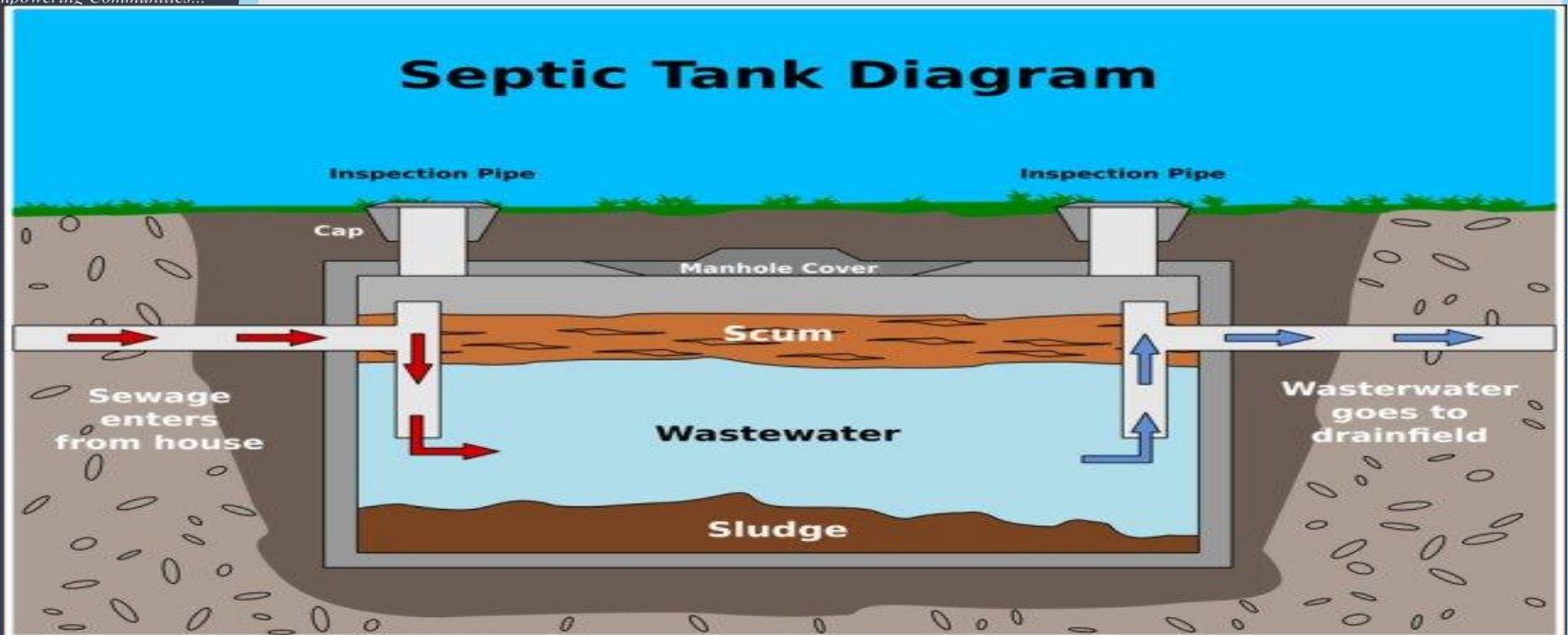
Due to the presence of anaerobic bacteria in waste water Heavy solids are reduced to sludge and gases.

Generally, if the density of solids which is more than the water is settled at the bottom of tank, if density of solids which is less than the water floats. The settled Solids is called as **Sludge** and floating solids is called as **scum**.



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Some things which can be done to prolong the life of a Septic System:

- Pump out the accumulated solids from the Septic Tank regularly (check it every 3 years, and typically pump it every 5-7 years).
- Don't overload it (minimize water usage).
- Don't put things which don't readily decompose into a Septic System (grease, cooking oils, sanitary napkins, chemicals, etc).
- Don't drive on it, or build over it.



• Advantage

1. It can be easily constructed.
2. No maintenance problem.
3. It excellently remove BOD.
4. Very less amount of solids are produced.
5. Low cost

Disadvantage

1. Its size should be very large to serve many people.
2. Smell problem
3. It needs periodic cleaning.



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The design of Septic Tank:-

Septic tank Consists of Top Slab, Bottom Slab with PCC Bed, Shear walls around the tank and a top cover (Opening) to check the level of Waste water. Below are the septic tank design calculations.

How to design Septic System?

For clear understanding here we designing a septic tank for 8 people in a house which get filled in 10 Days.

The average waste generated from each human / Day including kitchen waste = 95 to 150 liters/Day.

The average waste generated from each human includes Bathing & toilet = 85 liters/day

Cooking = 1 liters/day

Cleaning house = 2 liters/day

Washing utensils & clothes = 6 liters/day

Others = 1 liters/day

The values may change as per location and atmospheric conditions.



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Calculation:-

Total Members in house = 8 (Assume)

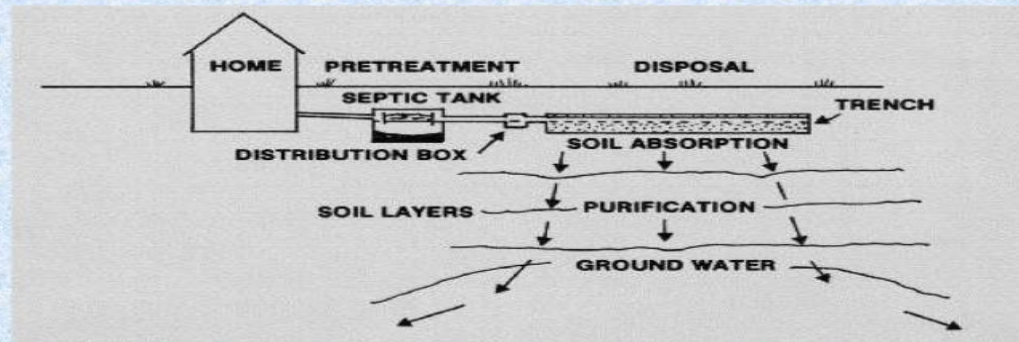
Total Waste Generated by House = $8 \times 130 = 1040$ lts/Day [Considering 130Lts]

The Total waste generated by house in 10 days = $10 \times 1040 = 10,400$ lts

Remember , $1\text{m}^3 = 1000$ litres (**Standard**)

So, For 10,400lts = **10.4 m**

TREAT SEWAGE SO THAT IT IS MADE HARMLESS.
DISPOSE OF SEWAGE (MAKE IT GO AWAY)





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Domestic energy consumption:-

Domestic energy consumption is the total amount of energy used in a house for household work. The amount of energy used per household varies widely depending on the standard of living of the country, the climate, and the age and type of residence.

Estimating the energy requirements and costs for powering an electronic device or appliance is very straightforward. There is a label at the back of each device that lists the watts that it uses. This is the number that you will need to figure out your energy usage and requirements. Along with the watts, you will need to estimate the number of hours each day that device or appliance is used.

Energy Consumption

Sr. no	Appliance	No. of appliances	Hours in use	Watt	Kwh
1	Tube Light	3	6	$20 \times 3 = 60$	0.36
2	Bulb	3	0.5	$100 \times 3 = 300$	0.15
3	CFL	1	4	15	0.06
4	Fan	2	3	$50 \times 2 = 100$	0.3
5	Refrigerator	1	24	110	2.64
6	Washing machine	1	0.50	200	0.06
7	Geyser	1	0.50	3000	1.5
8	Laptop	1	1	80	0.08
9	TV	1	4.5	98	0.441
10	Charger	2	2	$3 \times 2 = 6$	0.012
11	Mixer	1	0.08	200	0.016
12	Iron	1	0.08	550	0.044
				Total kwh/day	5.663
				Kwh/month	169.89

Scope for saving energy consumption

- As per given energy consumed by appliances and available options, the areas of concentrations are-
 - TV
 - BULBS
 - REFRIGERATOR
 - GEYSER
 - FANS

Low investment measures

- CFL instead of bulbs [4]
Price – Rs. 120 to 400
- Gas geyser instead of electric heater
Price- Rs. 4200
Running cost- Rs.150 per month
- Table fan [5]
Price- Rs. 1400/-

Sr no.	Appliances	Watts	Appliances	Watts
1	Gas Geyser	-	Electric geyser	3000
2	CFL	20	Bulb	100
4	Table fan	40	Ceiling fan	50



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Calculating Energy Consumption

The total amount of energy used by your household can be calculated simply by using six easy steps:

1. List the number of watts for each appliance or electronic device (this is called a “load” for each device). All existing and planned electrical loads should be identified.
2. Estimate the average daily use (the number of hours each day that the appliance or electronic device is running)
3. Multiply the unit's wattage by the number of hours you use it (this will give you a certain amount of “watt-hours”). For example, if you use a 120-watt television for two hours per day. You can multiply the wattage by the number of hours used per day to obtain 240 watt-hours per day.
4. On your electric bill, the electricity is in kilowatt-hours. To compare the energy consumption in kilowatt-hours, we will need to convert watt-hours to kilowatt-hours. Since 1 kilowatt is equal to 1,000 watts, divide by 1000 to convert from watt-hours (Wh) to kilowatt-hours (kWh):

 $240 \text{ Wh} / 1000 = 0.24 \text{ kWh}$
5. To compare these numbers to your electric bill, we need to convert this number to the number of hours that the appliance or device uses per month. For example, $0.24 \text{ kWh} \times 30 \text{ days} = 7.2 \text{ kWh}$ per month.
6. To calculate electric costs and compare the costs with your electric bill, look at your electric bill to determine how much you pay per kWh. If your bill says that you pay \$0.12 per kilowatt-hour, the cost can be estimated as follows: $7.2 \text{ kWh per month} \times \$0.12 \text{ per kWh} = \$0.86 \text{ per month}$.

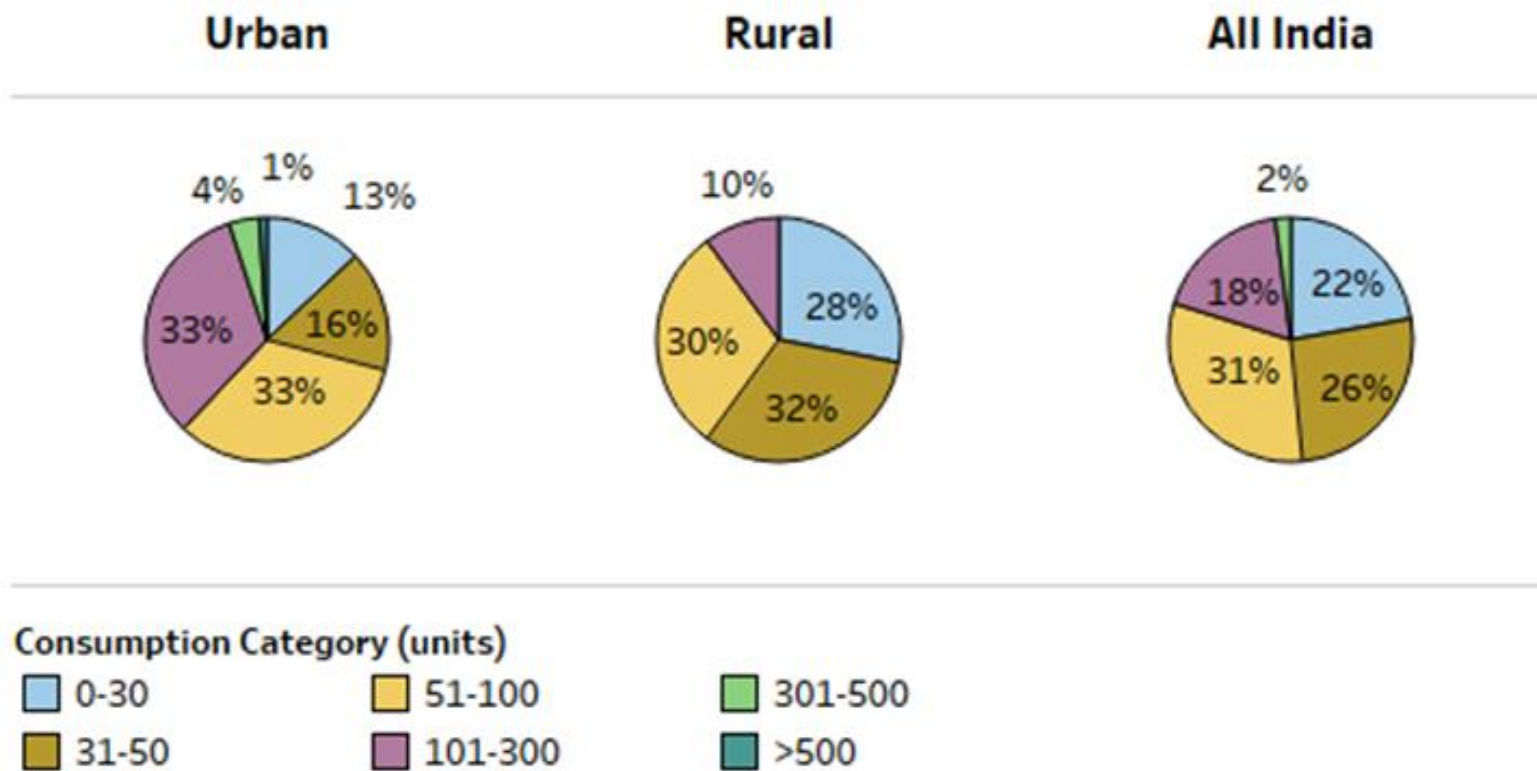


Figure : Households in India according to monthly consumption (in kWh or units)

Energy

- Energy is the capacity of a physical system to perform work. Energy exists in several forms such as heat, kinetic or mechanical energy, light, potential energy, electrical, or other forms.

>> Sources of Energy:

1. Conventional Energy Sources
2. Renewable Energy Sources



Conventional Energy Sources

- The term "Conventional" means "not unusual or extreme or ordinary." Conventional energy sources are the traditional sources of energy like coal and petroleum. Conventional energy sources are finite. **They will not last forever.**



Natural Gas

Natural gas in its purest form is pure methane but before it is refined, it also contains varying amount of ethane, propane, butane and carbon dioxide. When refined, it is colorless and odorless but can be burned to release large amounts of energy.

Conventional Energy Sources

Coal

Coal releases large amounts of energy when it is burned because of the density of hydrocarbons in the material. Coal is formed by dead plants being put under significant pressure and temperature for millions of years. There are four grades of coal: lignite, subbituminous, bituminous coal and anthracite. Bituminous coal is the best for releasing energy and is the most commonly mined type of coal .

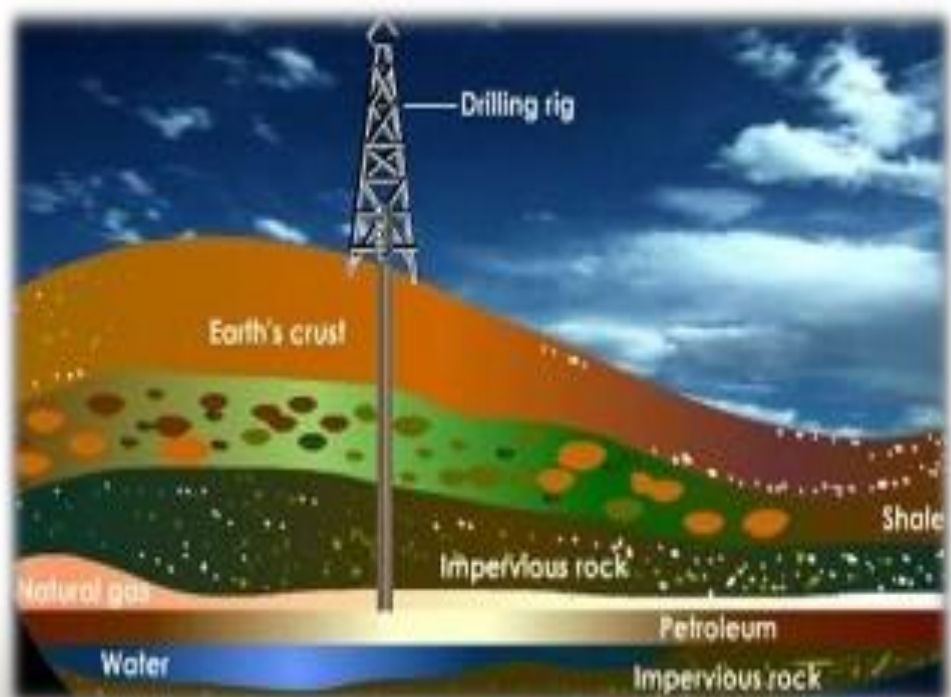


Conventional Energy Sources



Petroleum

Petroleum is formed from the compression of animal and plant remains over millions of years. Petroleum has to be drilled for because it is usually located deep below the earth's surface and is then refined to produce a number of different products including gasoline, heavy fuel oil and diesel fuel.



Renewable Energy Sources

A list of renewable energy sources:

- Biomass
- Hydro
- Geothermal
- Solar
- Tidal
- Wave
- Wind
- Wood



Renewable energy replaces conventional fuels in four distinct areas:

- power generation,
- hot water/ space heating,
- transport fuels and
- rural (off-grid) energy services.

WIND ENERGY

Wind power

- Airflows can be used to run wind turbines. Modern wind turbines range from around 600 kW to 5 MW of rated power, although turbines with rated output of 1.5–3 MW have become the most common for commercial use; the power output of a turbine is a function of the cube of the wind speed, so as wind speed increases, power output increases dramatically.



Hydropower

- Energy in water can be harnessed and used. Since water is about 800 times denser than air, even a slow flowing stream of water, or moderate sea swell, can yield considerable amounts of energy.
- There are many forms of water energy:

Micro hydro systems are hydroelectric power installations that typically produce up to 100 kW of power. They are often used in water rich areas as a remote-area power supply (RAPS). There are many of these installations around the world, including several delivering around 50 kW in the Solomon Islands.

Damless hydro systems derive kinetic energy from rivers and oceans without using a dam. Ocean energy describes all the technologies to harness energy from the ocean and the sea. This includes marine current power, ocean thermal energy conversion, and tidal power.

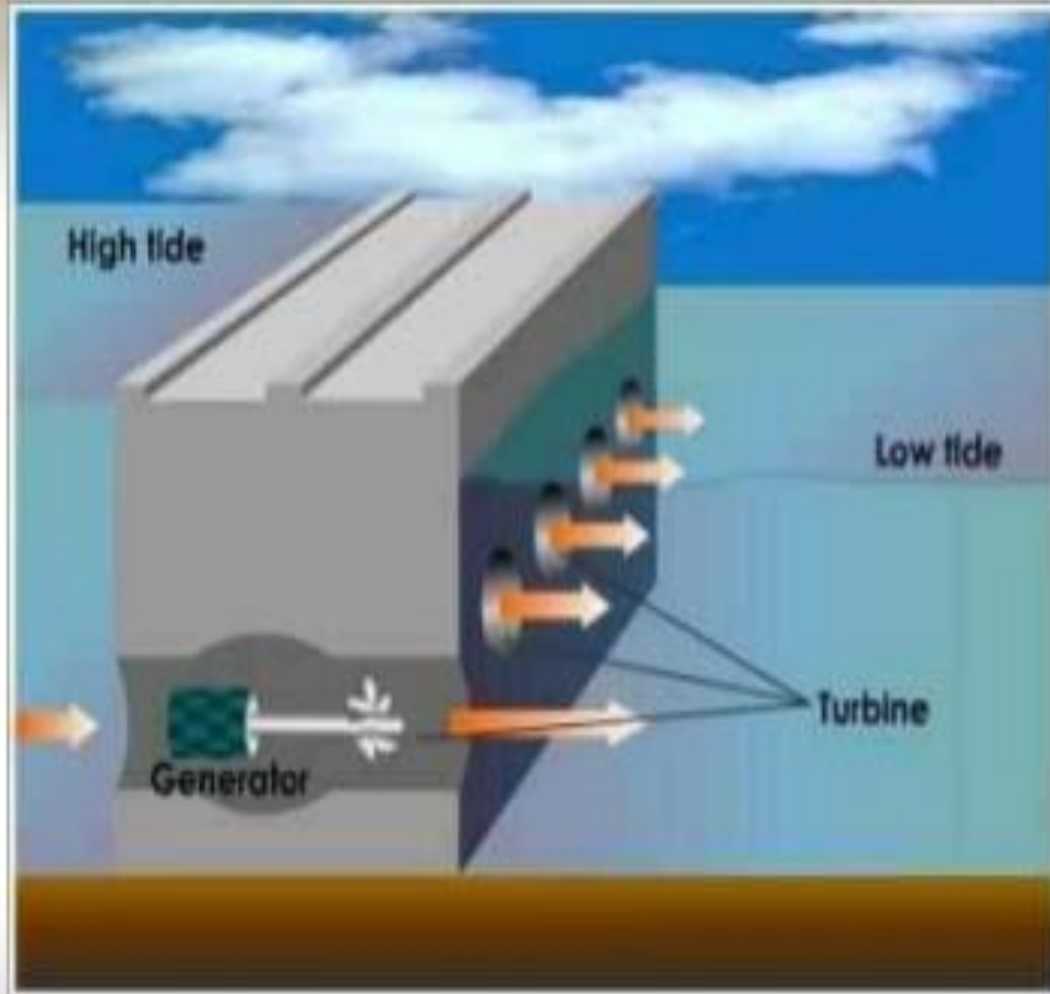
Solar energy

- Solar energy is the energy derived from the sun through the form of solar radiation. Solar powered electrical generation relies on photovoltaic and heat engines. A partial list of other solar applications includes space heating and cooling through solar architecture, day lighting, solar hot water, solar cooking, and high temperature process heat for industrial purposes.



Tidal Energy

- This is another unlimited and inexhaustible source of energy. The Gulfs of Kutch is preferably suited to build up electricity from the energy produced by high and lofty tides entering into slender creeks.



Rural Electrification

Earlier definition:

A village is classified as electrified if electricity is being used within its revenue area for any purpose what so-ever.

New definition:

- ❖ The basic infrastructure such as distribution transformer and or distribution lines is made available in the inhabited locality within the revenue boundary of the village including at least one hamlet/Dalit Basti as applicable.
- ❖ Any of the public places like Schools, Panchayat Office, Health Centres, Dispensaries, Community centers etc. avail power supply on demand.
- ❖ The number of household electrified should be minimum 10%.

Electrification of Households

<u>Overall electrification in the country</u>	<u>No. Households</u>	<u>Percentage</u>
Total no. of Households	138.27 million	
Households electrified	60.18 million	43.5%
Households yet to be electrified	78.09 million	56.5%

OBJECTIVES

Rural electrification is a big challenge today.

The main objective is to have :-

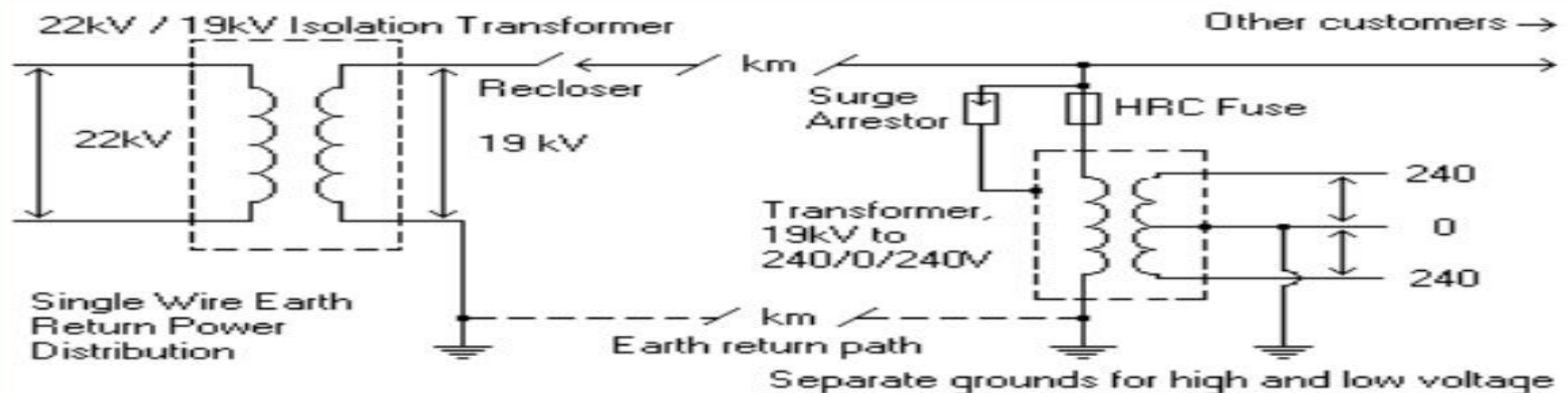
- Sustained
- Affordable
- Quality Access to electricity

Through planning of participative programs and monitoring efforts at the community level.

Technology

- One of the least expensive, most reliable, and best proven mains electricity distribution systems for rural electrification is **single wire earth return**.
- Locally generated renewable energy is an alternative technology, particularly compared to electrification with diesel generators.
- In some countries (particularly Bangladesh and India) hundreds of thousands of **Solar Home Systems** have been installed in the last years.

Single Wire Earth Return



Features of Rural Electrification



Run of river

- Perennial river required for continuous availability
- Suitable for small capacity & distributed generation
- No upstream pondage
- Siltation could be a constraint



Run of river
with pondage

- Upstream pondage to meet daily peak demand
- Suitable for small capacity & distributed generation



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Rural electrification has these advantages:

- 1. It will reduce isolation.**
- 2. It will improve health care and quality of life.**
- 3. It will help farmers be more productive.**
- 4. It will improve safety in the community.**
- 5. It will give them light.**