ENERGY SOURCES

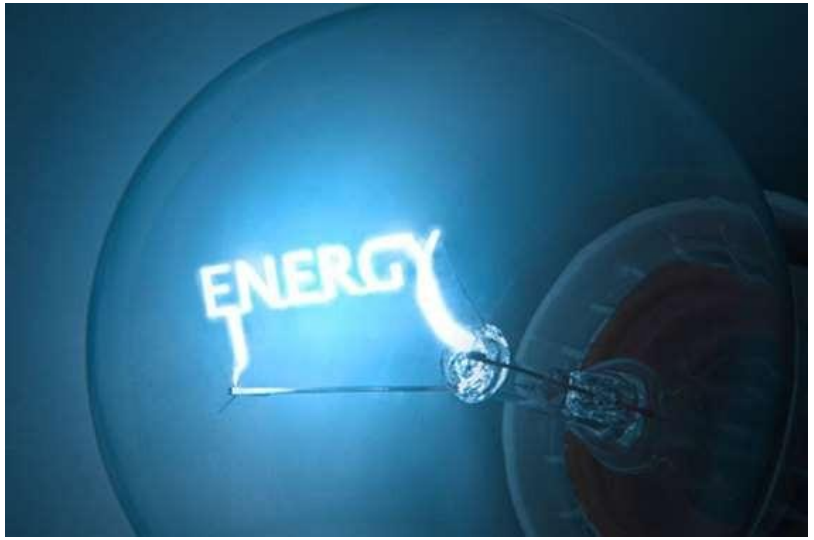
Energy

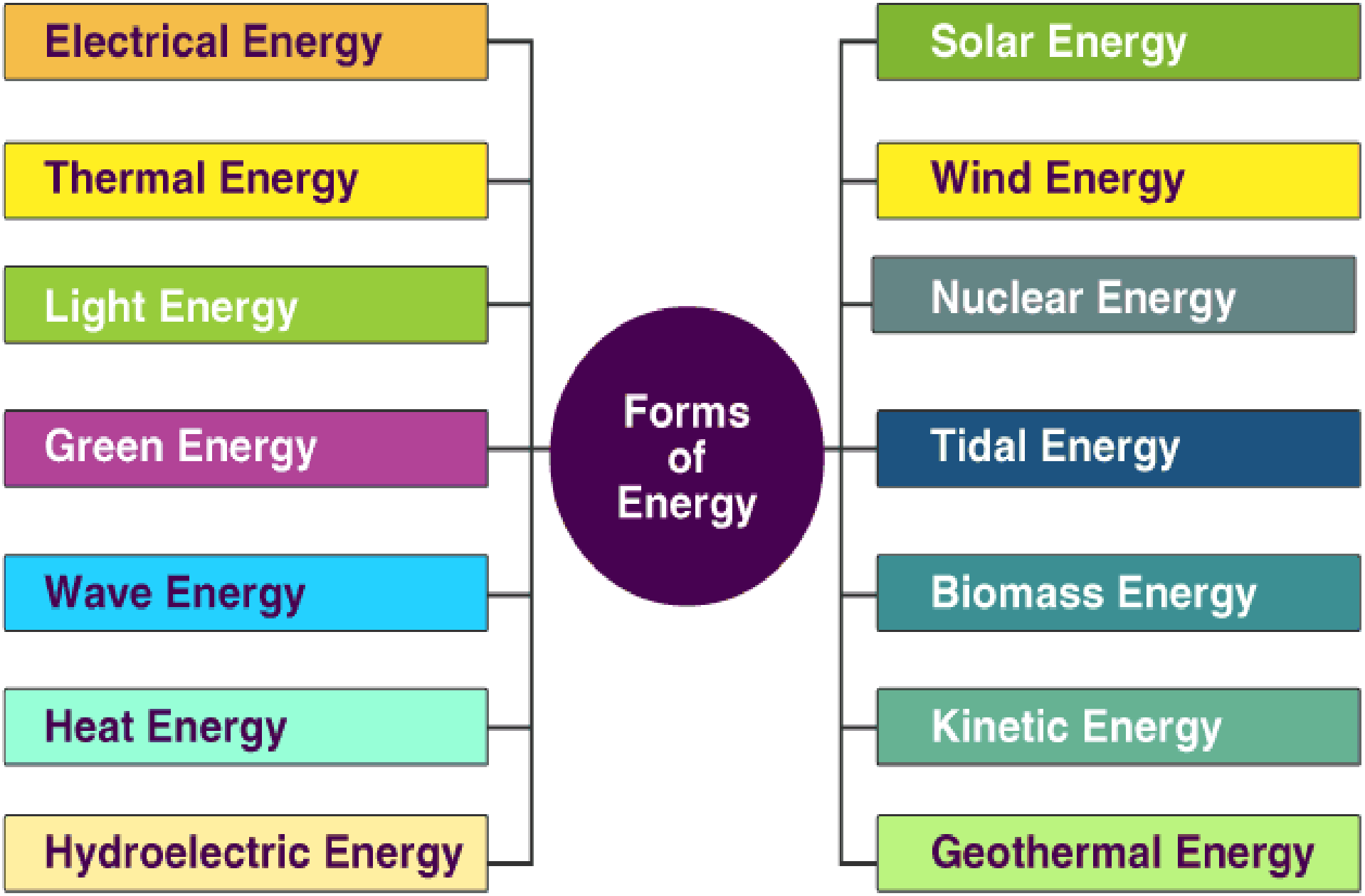
Energy is the capacity of a physical system to perform work. Energy exists in several forms such as heat, kinetic or mechanical energy, light, potential energy, electrical, or other forms.

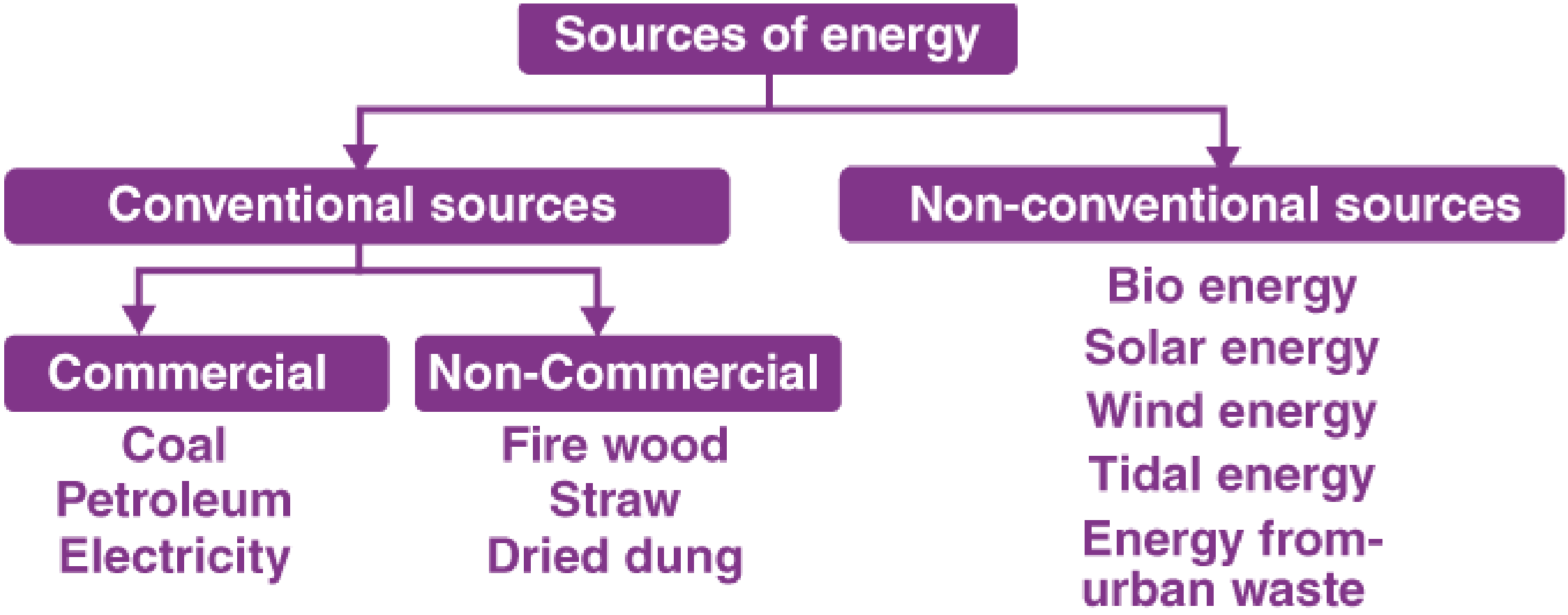
Sources of Energy:

1. Conventional/Non Renewable Energy Sources

2. Renewable Energy Sources




Forms of Energy
Electrical Energy
Thermal Energy
Light Energy
Green Energy
Wave Energy
Heat Energy
Hydroelectric Energy
Solar Energy
Wind Energy
Nuclear Energy
Tidal Energy
Biomass Energy
Kinetic Energy
Geothermal Energy


Sources of energy
Conventional sources
Non-conventional sources
Commercial
Non-Commercial
Coal
Petroleum
Electricity
Fire wood
Straw
Dried dung
Bio energy
Solar energy
Wind energy
Tidal energy
Energy from-
urban waste

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

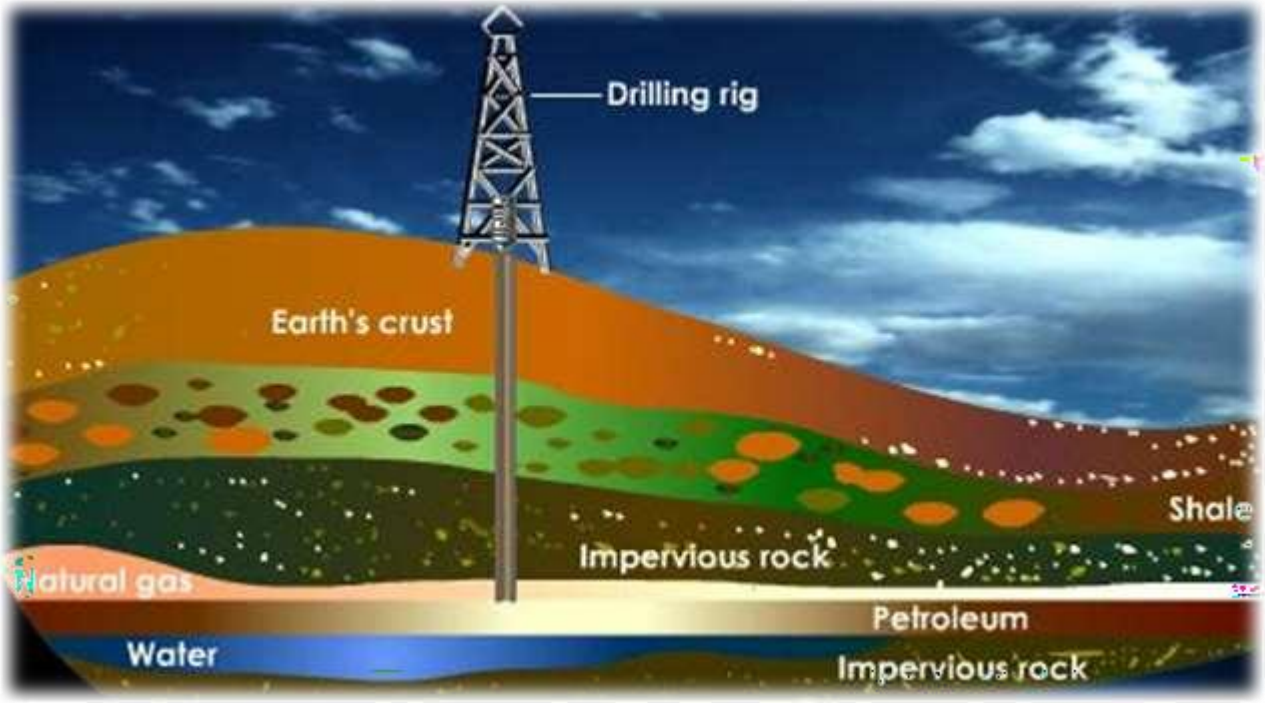
Coal

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.



Conventional Energy Sources

Advantages of Conventional Energy Sources

Conventional energy sources are proven technologies which can provide energy regardless of the weather conditions unlike solar and wind power which may go for days without being able to produce substantial amounts of power. Currently, the financial costs are much lower than alternative energy sources.

Conventional Energy Sources

Disadvantages of Conventional Energy Sources

- Petroleum, gas and coal are non renewable energy sources which means that they will eventually run out.
- These energy sources also release greenhouse gases like carbon dioxide into the atmosphere which contribute to global warming.
- Other pollutants released include sulphur and nitrogen oxide, which can lead to acid rain and mercury, which is harmful to humans when ingested.

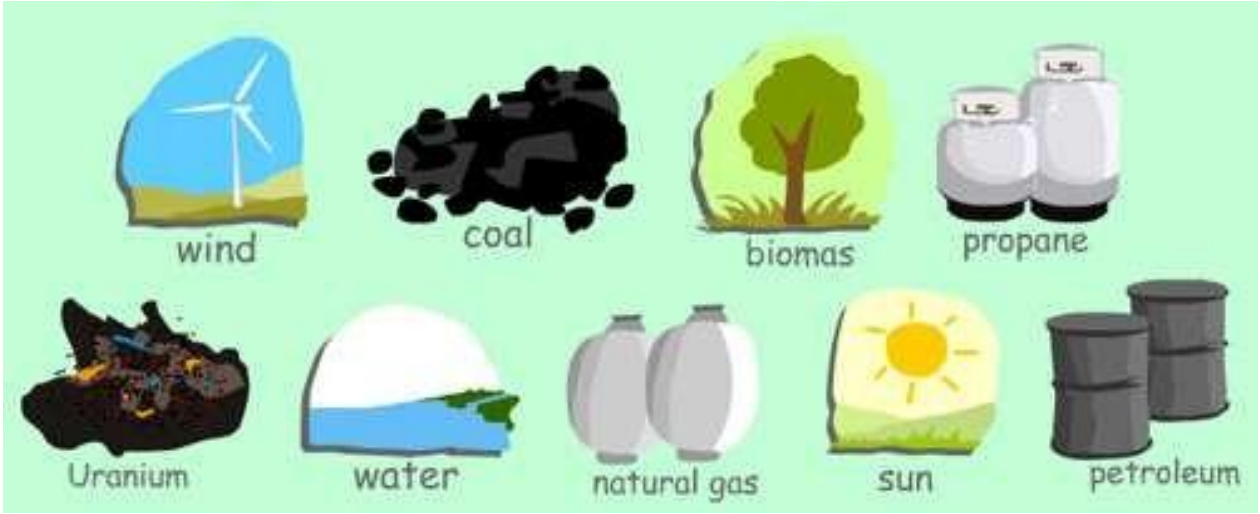
Renewable Energy Sources

- Renewable energy is natural energy which does not have a limited supply. Renewable energy can be used again and again, and will never run out.
- Renewable energy is energy which comes from natural resources such as sunlight, wind, rain, tides and geothermal heat, which are renewable (naturally replenished.)
- Renewable energy is an alternative to fossil fuels and nuclear power, and was commonly called alternative energy.

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

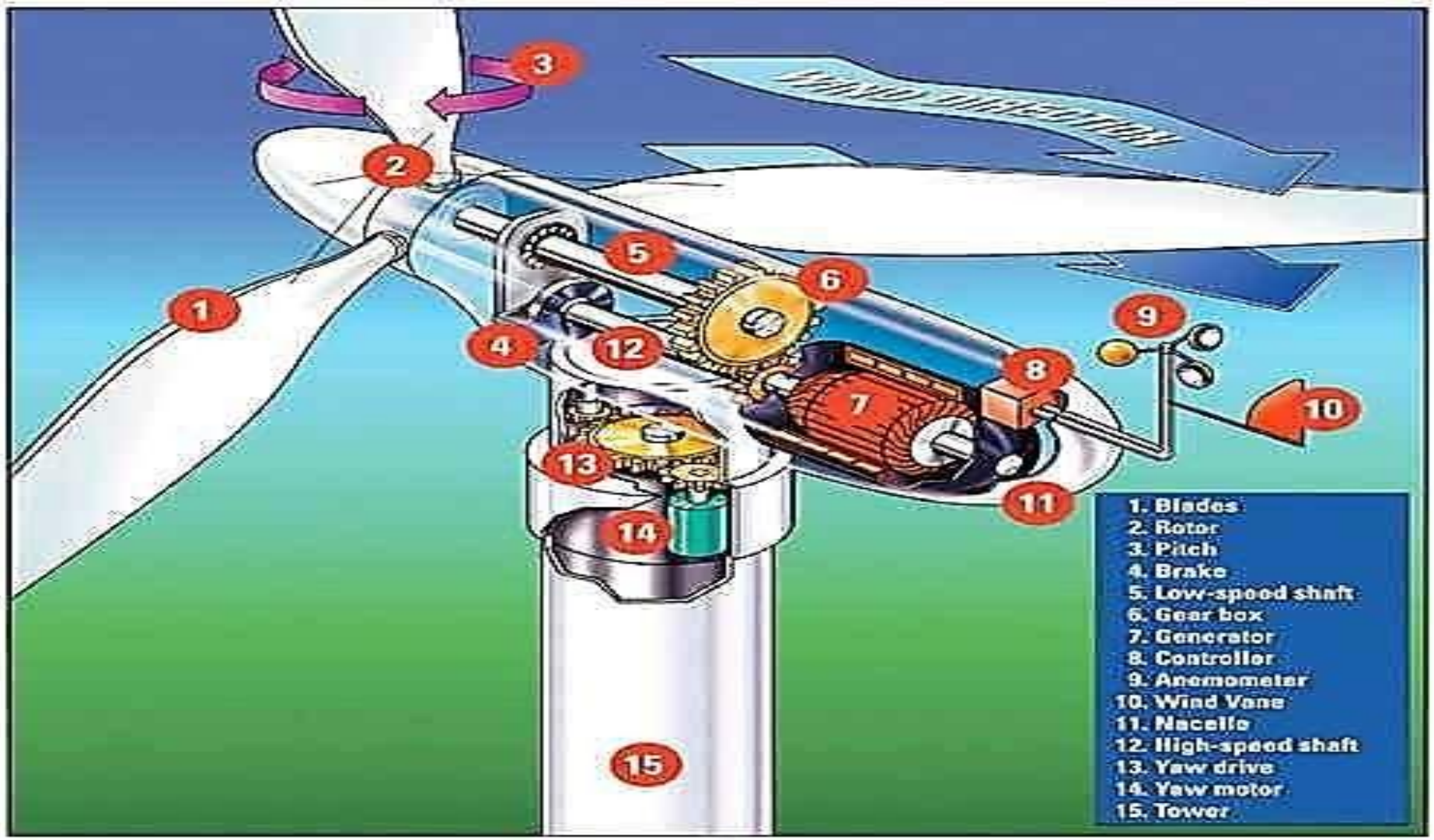
Wind power

- 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.

WIND ENERGY

- Areas where winds are stronger and more constant, such as offshore and high altitude sites, are preferred locations for wind farms. Typical capacity factors are 20-40%, with values at the upper end of the range in particularly favorable sites.

WIND ENERGY


WIND DIRECTION
1. Blades
2. Rotor
3. Pitch
4. Brake
5. Low-speed shaft
6. Gear box
7. Generator
8. Controller
9. Anemometer
10. Wind Vane
11. Nacelle
12. High-speed shaft
13. Yaw drive
14. Yaw motor
15. Tower

WIND ENERGY

- Globally, the long-term technical potential of wind energy is believed to be five times total current global energy production, or 40 times current electricity demand. This could require wind turbines to be installed over large areas, particularly in areas of higher wind resources. Offshore resources experience mean wind speeds of ~90% greater than that of land, so offshore resources could contribute substantially more energy.

Hydropower

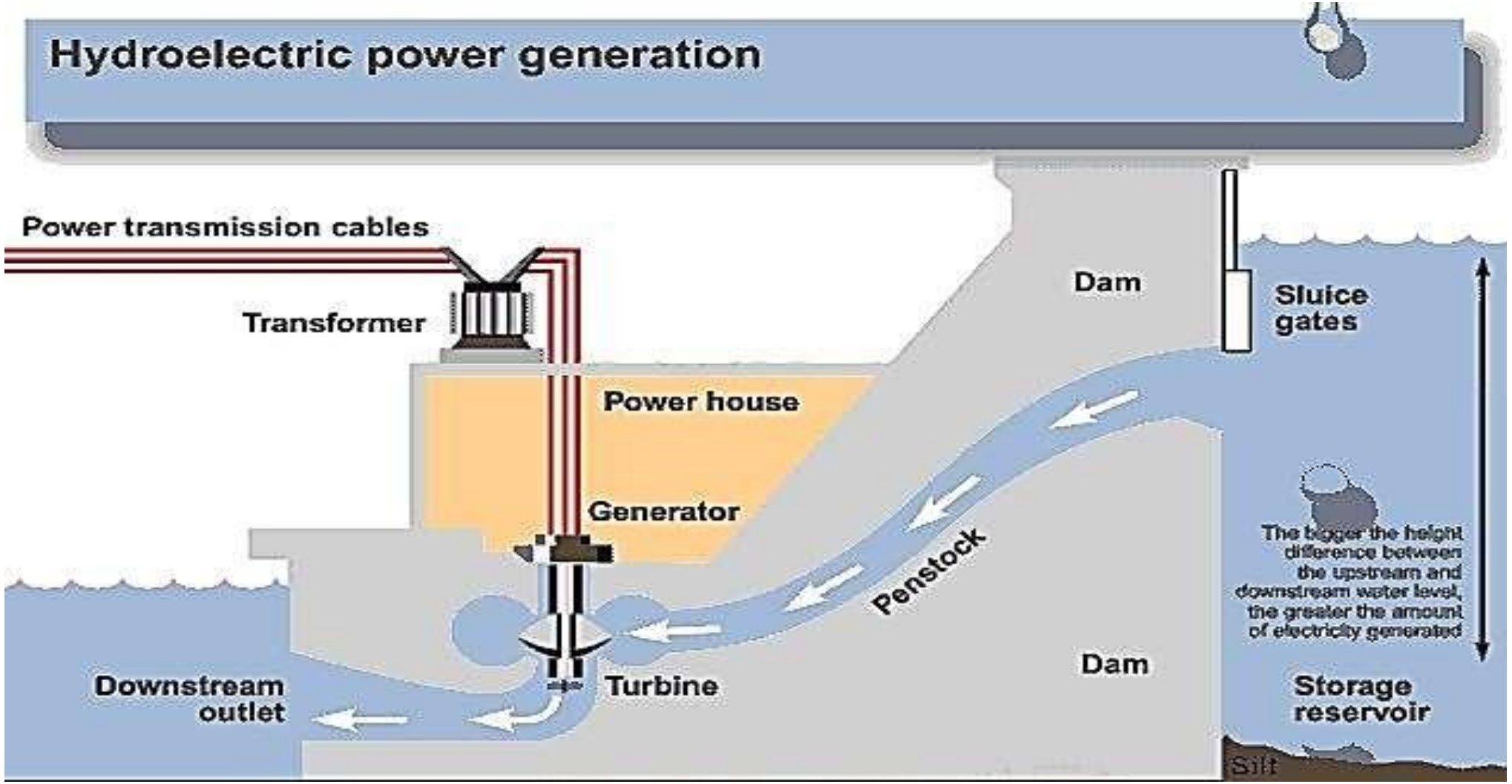
- Energy in water can be harnessed and used. Since water is about 800 times denser than air, even a slow flowing stream of water, or moderate sea swell, can yield considerable amounts of energy.

- 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.

Hydropower


Hydroelectric power generation
Power transmission cables
Transformer
Power house
Generator
Dam
Sluice gates
Penstock
The bigger the height difference between the upstream and downstream water level, the greater the amount of electricity generated
Dam
Turbine
Downstream outlet
Storage reservoir
Silt

Hydropower

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.

Solar energy

- Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy.

- Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy.

- Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air.

Biomass

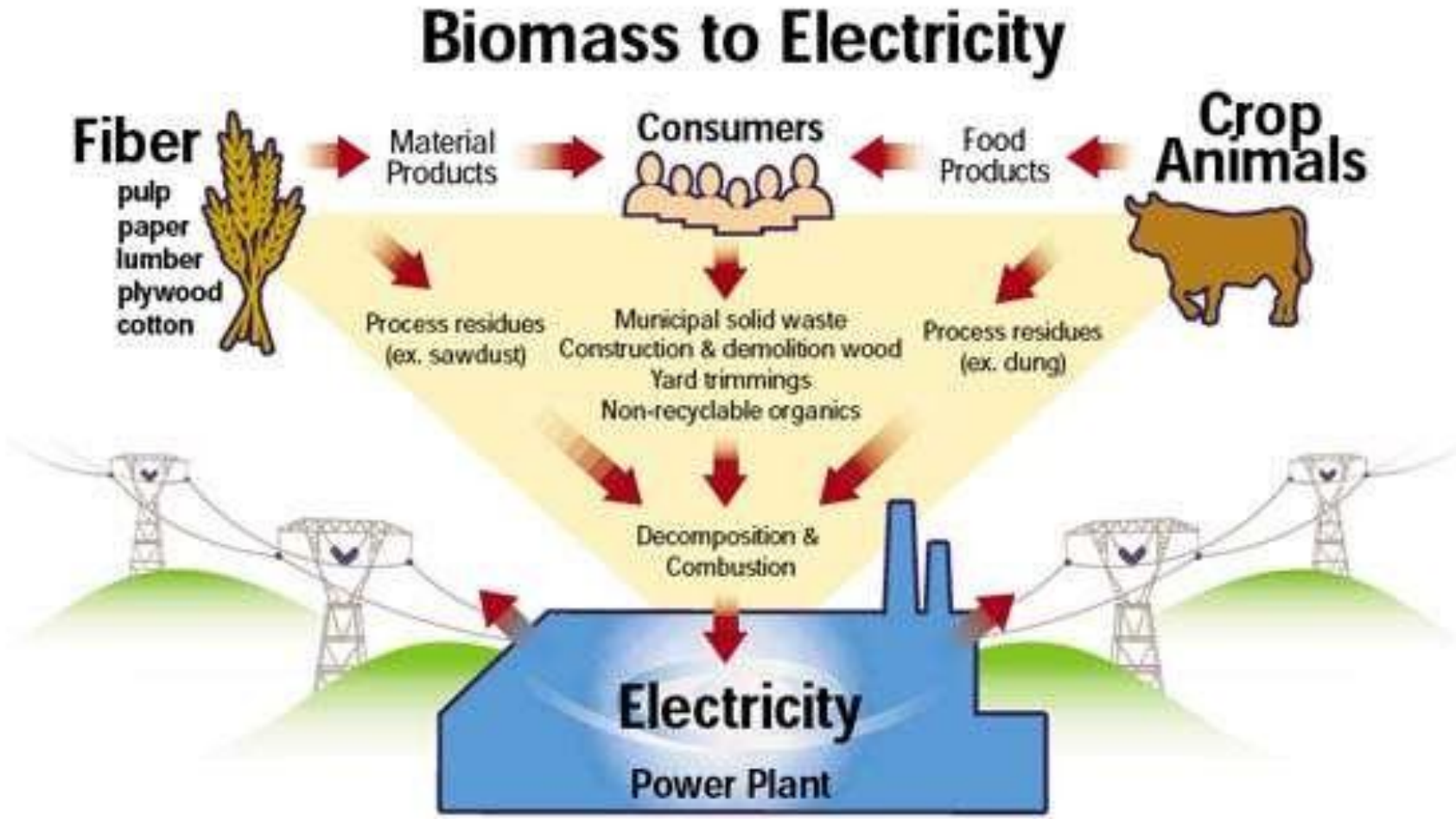
Biomass (plant material) is a renewable energy source because the energy it contains comes from the sun. Through the process of photosynthesis, plants capture the sun's energy. When the plants are burned, they release the sun's energy they contain. In this way, biomass functions as a sort of natural battery for storing solar energy. As long as biomass is produced sustainably, with only as much used as is grown, the battery will last indefinitely.

In general there are two main approaches to using plants for energy production: growing plants specifically for energy use, and using the residues from plants that are used for other things. The best approaches vary from region to region according to climate, soils and geography.

Biomass

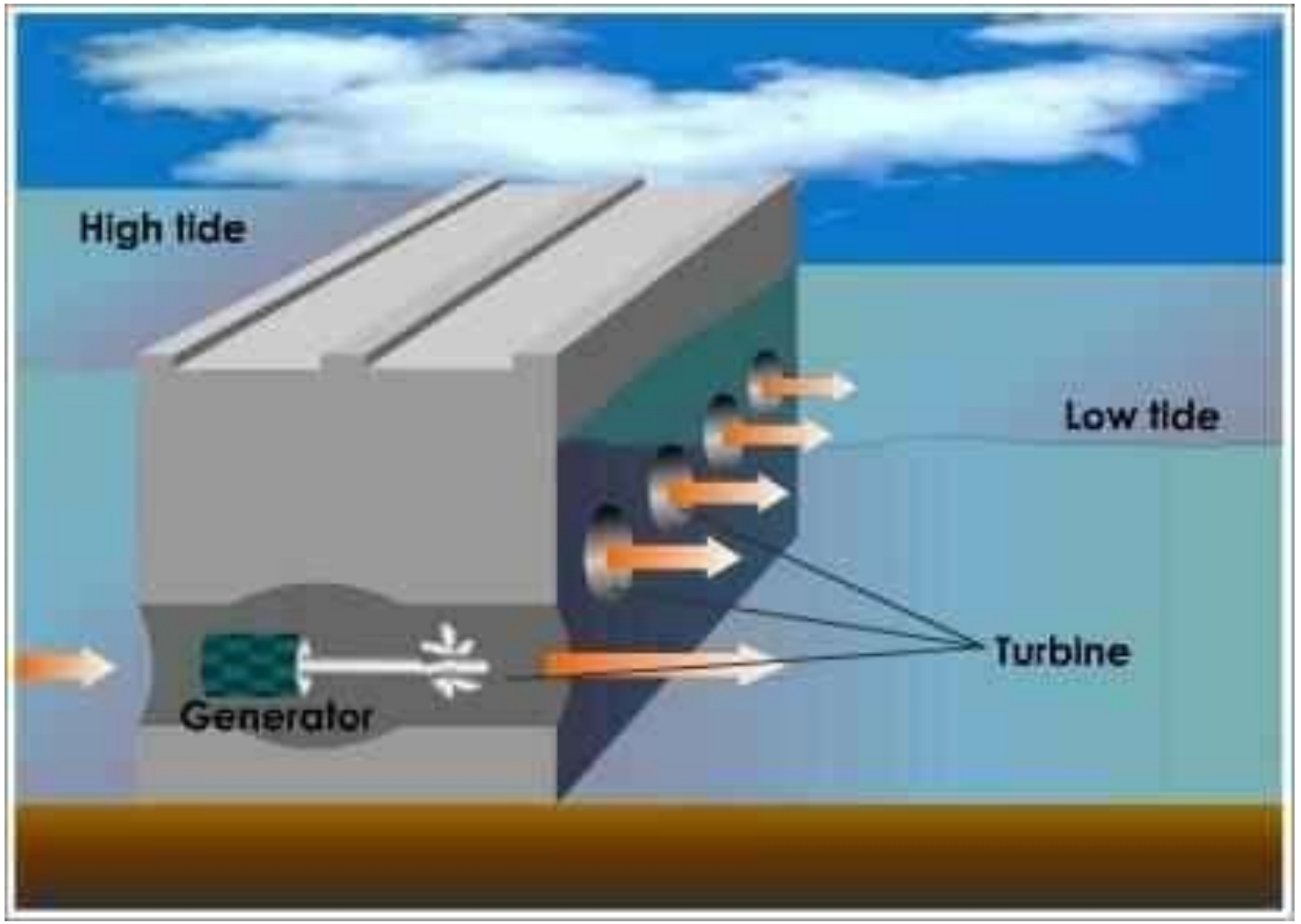

Sewage
Municipal Solid Waste
Agricultural Crops & Residueps
Biomass Sources
Animal Residues
Forestry Crops & Residue
Industrial Residues
Biomass Innovation Centre
Fueling growth through clean technology
educate > develop > implement

Biomass

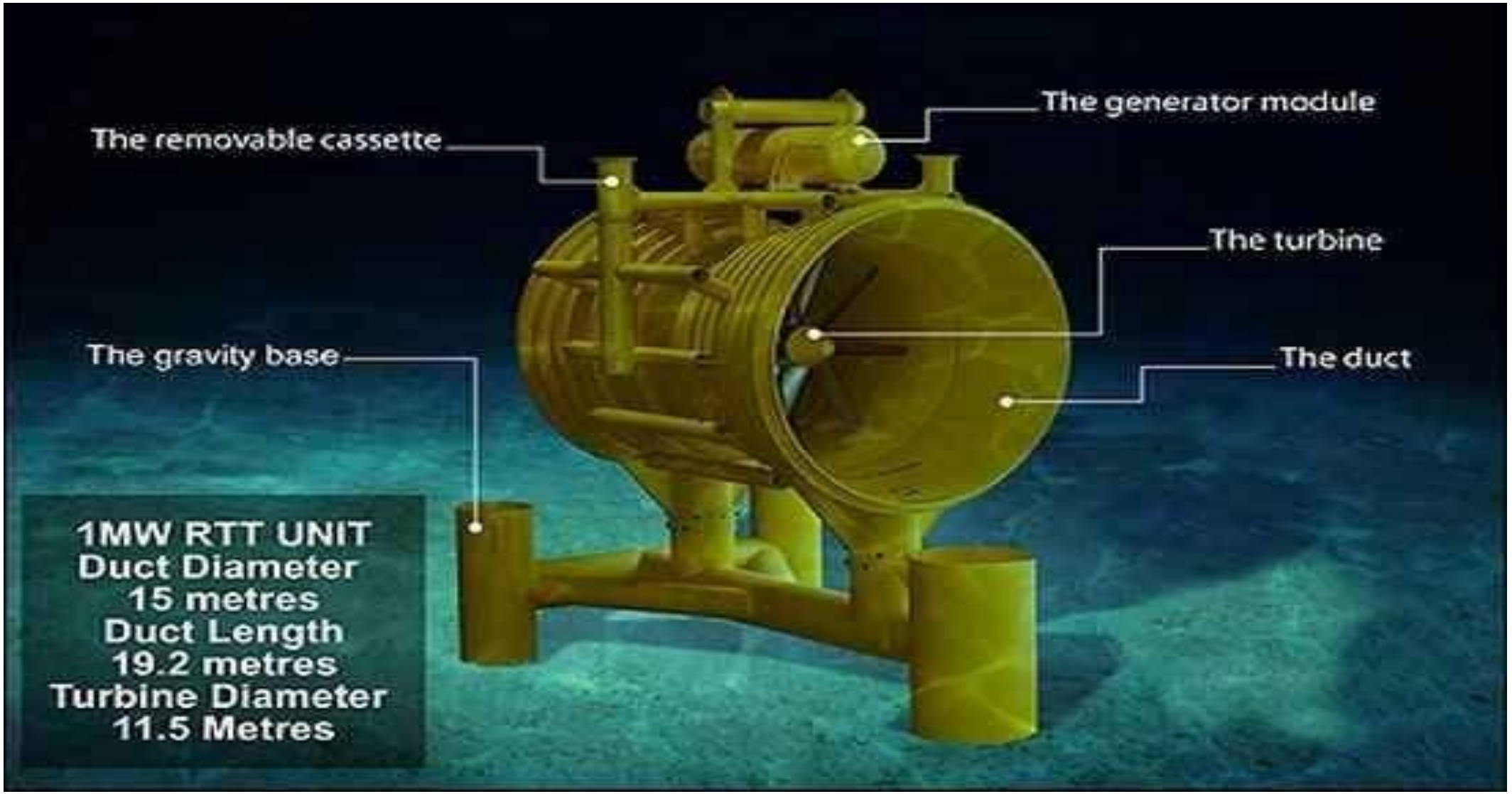

Biomass to Electricity
Fiber
pulp
paper
lumber
plywood
cotton
Material Products
Consumers
Food Products
Crop Animals
Process residues (ex. sawdust)
Municipal solid waste
Construction & demolition wood
Yard trimmings
Non-recyclable organics
Process residues (ex. dung)
Decomposition & Combustion
Electricity
Power Plant

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.



Tidal Energy



Tidal Energy

Biofuel

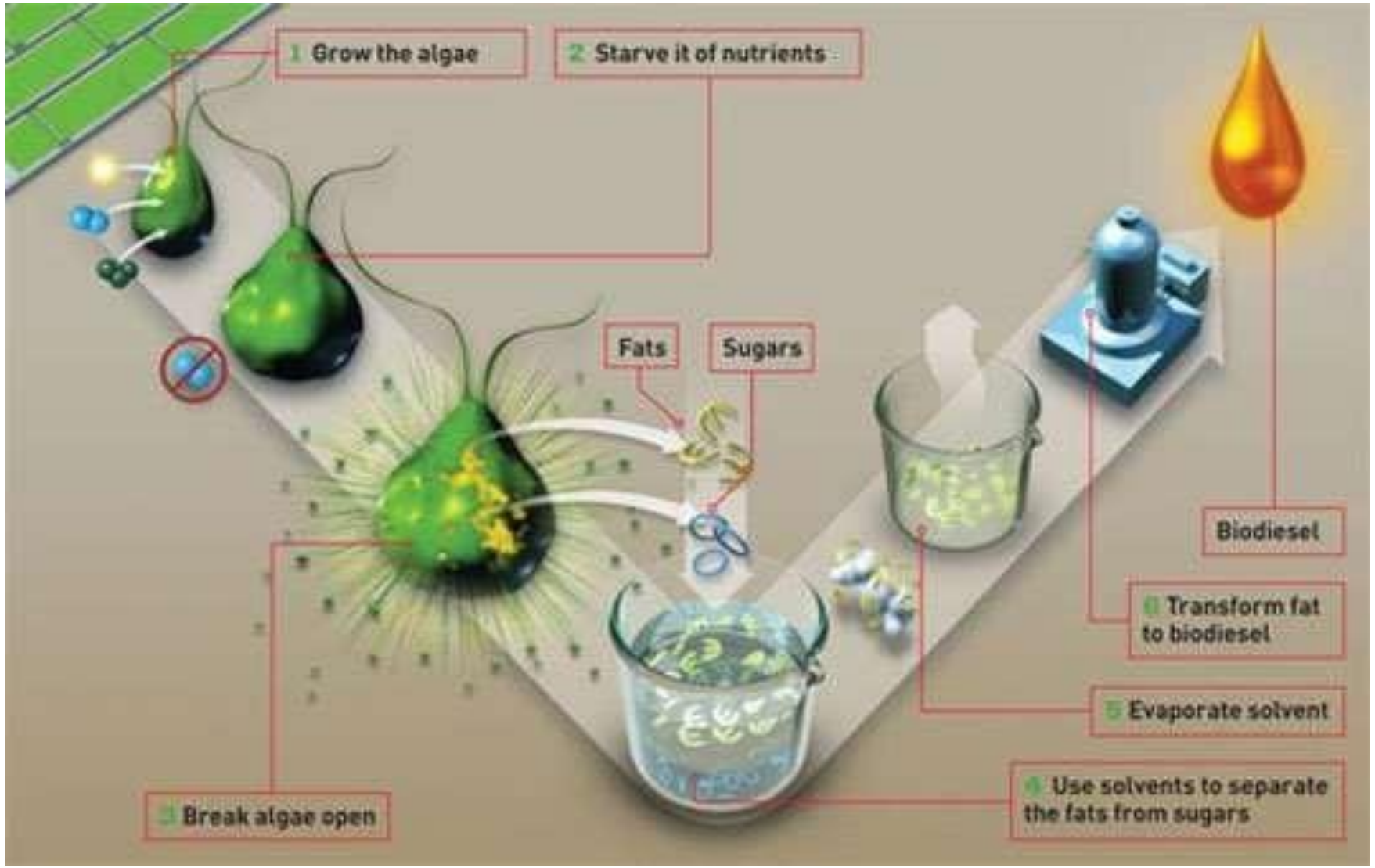
- Liquid biofuel is usually either bio alcohol such as bioethanol or an oil such as biodiesel.

- Bioethanol is an alcohol made by fermenting the sugar components of plant materials and it is made mostly from sugar and starch crops. With advanced technology being developed, cellulosic biomass, such as trees and grasses, are also used as feedstock for ethanol production.

- Ethanol can be used as a fuel for vehicles in its pure form, but it is usually used as a gasoline additive to increase octane and improve vehicle emissions.

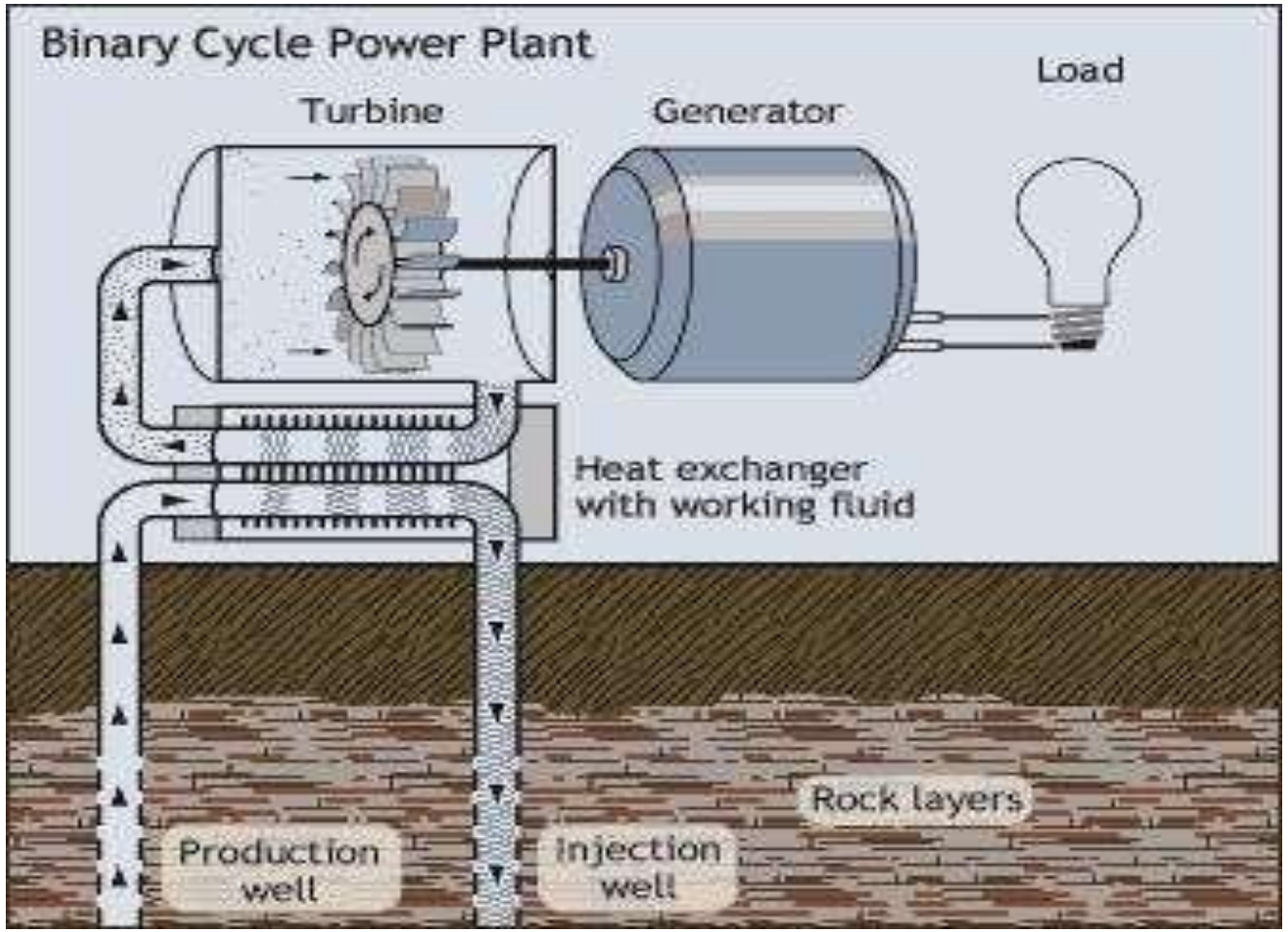
- Biodiesel is made from vegetable oils, animal fats or recycled greases. Biodiesel can be used as a fuel for vehicles in its pure form, but it is usually used as a diesel additive to reduce levels of particulates, carbon monoxide, and hydrocarbons from diesel-powered vehicles. Biodiesel is produced from oils or fats using trans esterification.

Biofuel


1 Grow the algae
2 Starve it of nutrients
Fats
Sugars
Biodiesel
4 Transform fat to biodiesel
5 Evaporate solvent
6 Use solvents to separate the fats from sugars
3 Break algae open

Geothermal energy

- Geothermal energy is energy obtained by tapping the heat of the earth itself, both from kilometers deep into the Earth's crust in volcanically active locations of the globe or from shallow depths, as in geothermal heat pumps in most locations of the planet.
- It is expensive to build a power station but operating costs are low resulting in low energy costs for suitable sites. Ultimately, this energy derives from heat in the Earth's core.



Geothermal energy

- Three types of power plants are used to generate power from geothermal energy: dry steam, flash, and binary.

- Dry steam plants take steam out of fractures in the ground and use it to directly drive a turbine that spins a generator.

- Flash plants take hot water, usually at temperatures over 200 °C, out of the ground, and allows it to boil as it rises to the surface then separates the steam phase in steam/water separators and then runs the steam through a turbine.

- In binary plants, the hot water flows through heat exchangers, boiling an organic fluid that spins the turbine. The condensed steam and remaining geothermal fluid from all three types of plants are injected back into the hot rock to pick up more heat.

- The geothermal energy from the core of the Earth is closer to the surface in some areas than in others. Where hot underground steam or water can be tapped and brought to the surface it may be used to generate electricity.

Advantages of renewable energy sources

- Renewable energy sources consist of solar, hydro, wind, geothermal, ocean and biomass. The most common advantage of each is that they are renewable and cannot be depleted.

- They are clean energy, as they don't pollute the air, and they don't contribute to global warming or greenhouse effects.

- Since their sources are natural the cost of operations is reduced and they also require less maintenance on their plants.

Disadvantages of Renewable energy sources

A common disadvantage to all is that it is difficult to produce the large quantities of electricity their counterpart the fossil fuels are able to. Since they are also new technologies, the cost of initiating them is high.

- Wind : turbines are expensive. Wind doesn't blow all the time, so they have to be part of a larger plan.
- Solar :panels are expensive. Governments are not all willing to buy home generated electricity. Not all climates are suitable for solar panels.
- Waves : different technologies are being tried around the world. Scientists are still waiting for the killer product.
- Tides : barrages (dams) across river mouths are expensive to build and disrupt shipping. Smaller turbines are cheaper and easier to install.

Disadvantages of Renewable energy sources

- Rivers : Dams are expensive to build and disrupt the environment. They have also caused earthquakes.
- Geothermal : Difficult to drill two or three kilometers down into the earth.
- Biofuel : Often uses crop lands and crops (like corn) to produce the bio-alcohol. This means that more land has to be cleared to grow crops, or there is not enough food, or that food becomes more expensive.

Fossil Fuels

- Fossil fuels are buried flammable geologic deposits of organic substances such as dead plants, and animals that got deposited under several thousand feet of silt.

- These deposits decayed with the passage of time and got converted to natural gas, coal, and petroleum due to the extreme heat and pressure inside the earth’s crust. They are also known as non-renewable sources of energy as it takes a very long time for it to replenish.

Types of Fossil Fuels

- Coal
- Petroleum
- Natural gas

Coal

- It is a hard, black coloured substance made up of carbon, hydrogen, nitrogen, oxygen, and sulphur.
- The major types of coal are- anthracite, bituminous and lignite.
- Anthracite has a higher carbon concentration and is the hardest type of coal.
- Lignite has a high concentration of oxygen and hydrogen but a low concentration of carbon.
- Bituminous is a moderate form of coal.
- Coal is processed industrially to obtain derivatives like coke, coal tar, and coal gas.

Types of Fossil Fuels

Formation of Coal

- The process of formation of coal is known as coalification.
- The dense forest present in the low-lying wetland got buried in the earth, millions of years ago.
- Soil kept depositing over them and they got compressed.
- As they went deeper and deeper, they faced high temperature and pressure.
- As a result, the substances slowly got converted into coal.

Uses of Coal

- Coal was used to produce steam in the railway engines initially.
- It is used to cook food.
- It is used to generate electricity in thermal plants.
- It is used in industries as fuel.

Types of Fossil Fuels

Petroleum

- It is a clear, oily liquid, usually green or black in colour.
- It has a very strange smell and is a mixture of petroleum gas, diesel, paraffin wax, petrol, lubricating oil, etc.
- It is also termed as “Black Gold” because of its wide range of uses in many industries.

Formation of Petroleum

- The sea animals and plants died and their bodies settled at the bottom of the sea.
- They got compressed by the layers of sand and clay.
- Their encounter with high temperature and pressure converts them into petroleum.
- The petroleum is separated from the crude oil by a series of processes in a refinery. This is known as petroleum refining.

Types of Fossil Fuels

Uses of Petroleum

- It is used to power internal combustion engines in the form of petrol.
- It is used in roofing, road pavements, and as a water repellent.
- It is used in manufacturing detergents, plastics, fibres, polyethene, etc.

Natural gas

- It is a clean and non-toxic fossil fuel.
- It is colourless and odourless and can be easily transferred through pipelines.
- It is stored as compressed natural gas (CNG) under high pressure.
- It is a less polluting and less expensive fossil fuel.
- Methane is the most important natural gas.

Types of Fossil Fuels

Formation of Natural Gas

- The phytoplankton and zooplankton sink to the bottom of the ocean and mix with organic materials to form an organic-rich mud.
- The mud buried under more sediments and lithifies to form an organic shale. This prevents its exposure to oxygen. This is done to protect the organic materials from being decomposed by bacteria.
- The increasing pressure and temperature transform the shale into a waxy material known as the kerogen.
- At temperatures between 90-160°C kerogen is transformed into natural gas.

Uses of Natural gas

- Compressed Natural Gas is used for generating power.
- It is used as fuels in automobiles.
- It can be used at homes for cooking.
- It is used as a starting material in chemicals and fertilizers.

Types of Fossil Fuels

Are Fossil Fuels Renewable?

- Fossil fuels are a non-renewable source of energy. Most of the energy used by us is obtained by the burning of fossil fuels.

- These fossil fuels are used up at a faster rate. They cannot be regrown at a scale compared to their consumption.

- With the increased demand for the production of various energies, fossil fuel energy is declining. It is difficult to replace them. That is why they are known as a non-renewable source of energy.

Advantages and Disadvantages of Fossil Fuels

Advantages:

- Fossil fuels can generate a large amount of electricity at a single location.
- They can be found very easily.
- They are cost-effective.
- Transportation of oil and gas can be done easily through pipelines.
- They have become safer over time.
- Despite being a finite resource, it is available in plenty.

Advantages and Disadvantages of Fossil Fuels

Disadvantages:

- Fossil fuels emit carbon dioxide when burnt which is a major greenhouse gas and the primary source of pollution. This has contributed to global warming.

- They are a non-renewable resource, i.e., once used they cannot be replaced.

- Combustion of fossil fuels makes the environment more acidic. This has led to unpredictable and negative changes in the environment.

- Harvesting of fossil fuels also causes fatal diseases among the people. For eg., the coal miners often suffer from Black Lung Disease. The natural gas drillers are constantly exposed to chemicals and silica which is dangerous for their health.

Environmental Impact of Fossil Fuel Use

- Carbon fuels
- Release of carbon monoxide gas into the atmosphere.
- Global warming
- Releases sulphur dioxide gas

Alternative to Fossil Fuels

- Bio Fuels
- Bio mass
- Algae based Fuels
- Bio Diesels
- Alcohol fuels
- Hydrogen Fuels

Merits and Demerits of Alternative Fuels

Merits

- Environmental benefit
- Increased energy security
- Sustainability
- Massive job creator

Demerits

- High Cost
- Low Efficiency
- Issue with the stability of the system
- Logistic problem for Installations.

Growing Energy Needs

- Coal, Oil, Gas, Water constitute main sources of energy in India
- Commercial consumption of energy from coal (56%) & Petroleum (32%) other sources as Natural Gas, Water
- Traditional Sources of energy : wood, agriculture waste & animal residue
- Industrial sectors consuming about 50% of total commercial energy
- Industrial energy consumption sources: fertilizer, aluminum, textiles, cement, iron and steel and paper
- Farm sector energy consumption increased from 3.9% in 1951 to 32.5% in 1997

Renewable Energy Sources

- Wind Energy: In 2014, world can produce 3% of total electricity
- Hydropower: In 2015, Hydropower generated 16.6% of world electricity & 70% of all renewal electricity.
- Solar Energy: In 2014, less 1% of world total grid electricity
- Geothermal Energy: Heat to earth around 4600km down with 5000 degree temperature
- Bio Energy: Energy from living organism, bio- fuels provided 2.7% of world's transport fuels in 2010

Fuel Cells

Hydrogen Fuel Cell

A fuel cell combines hydrogen and oxygen to produce electricity, heat, and water. Fuel cells are often compared to batteries. Both convert the energy produced by a chemical reaction into usable electric power.

Nuclear Energy

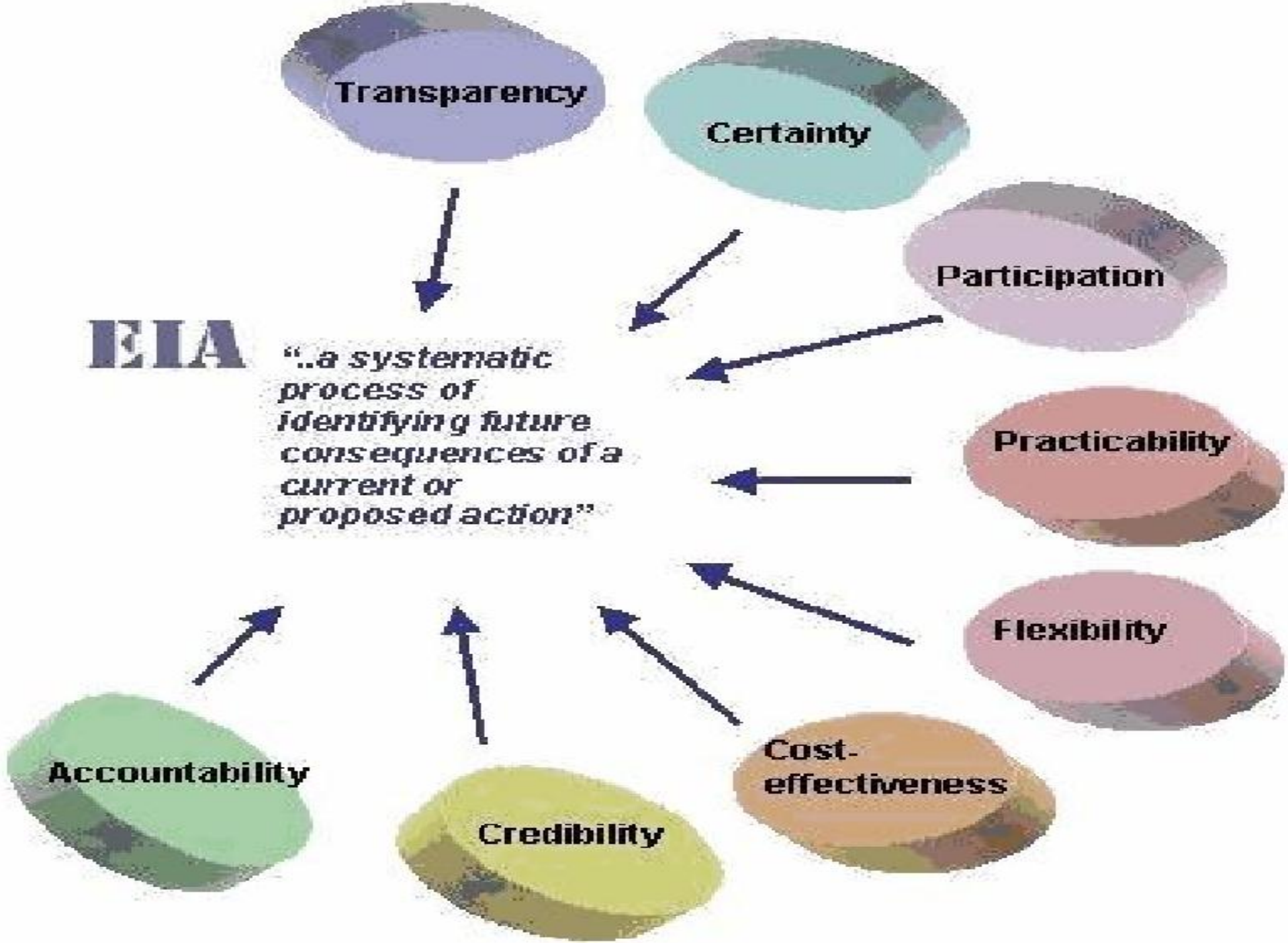
Nuclear Energy

Nuclear energy is the energy in the nucleus, or core, of an atom.

ENVIRONMENTAL IMPACT ASSESSMENT

Environmental Impact Assessment (EIA) is a process which ensures that all environmental matters are taken into account quite early in the project at planning process itself.

It takes into consideration not only technical and economic considerations but also, traditional aspects like impact on local people, biodiversity etc.


Transparency
Certainty
Participation
EIA
"..a systematic process of identifying future consequences of a current or proposed action"
Practicability
Flexibility
Cost-effectiveness
Credibility
Accountability

WHY EIA?

EIA is intended to prevent or minimize potentially adverse environmental impacts and enhance the overall quality of a project. The main benefits and advantages of EIAare:

- Lower project costs in the long-term
- Increased project acceptance
- Improved project design

HISTORY OF EIA IN INDIA

Started in 1976-77, when Planning Commission asked Department of Science & Technology to examine River Valley Projects from environmental angle

Till 1994, Environmental Clearance from Central Government was an administrative decision which lacked legislative support.

On 27th January 1994, Union Ministry of Environment & Forests, GOI under Environment (Protection) Act 1986, promulgated EIA notification making Environment clearance mandatory for expansion or modernization of any activity or for setting up new projects listed in Schedule one of the notification, which have been amended more than 12 times.

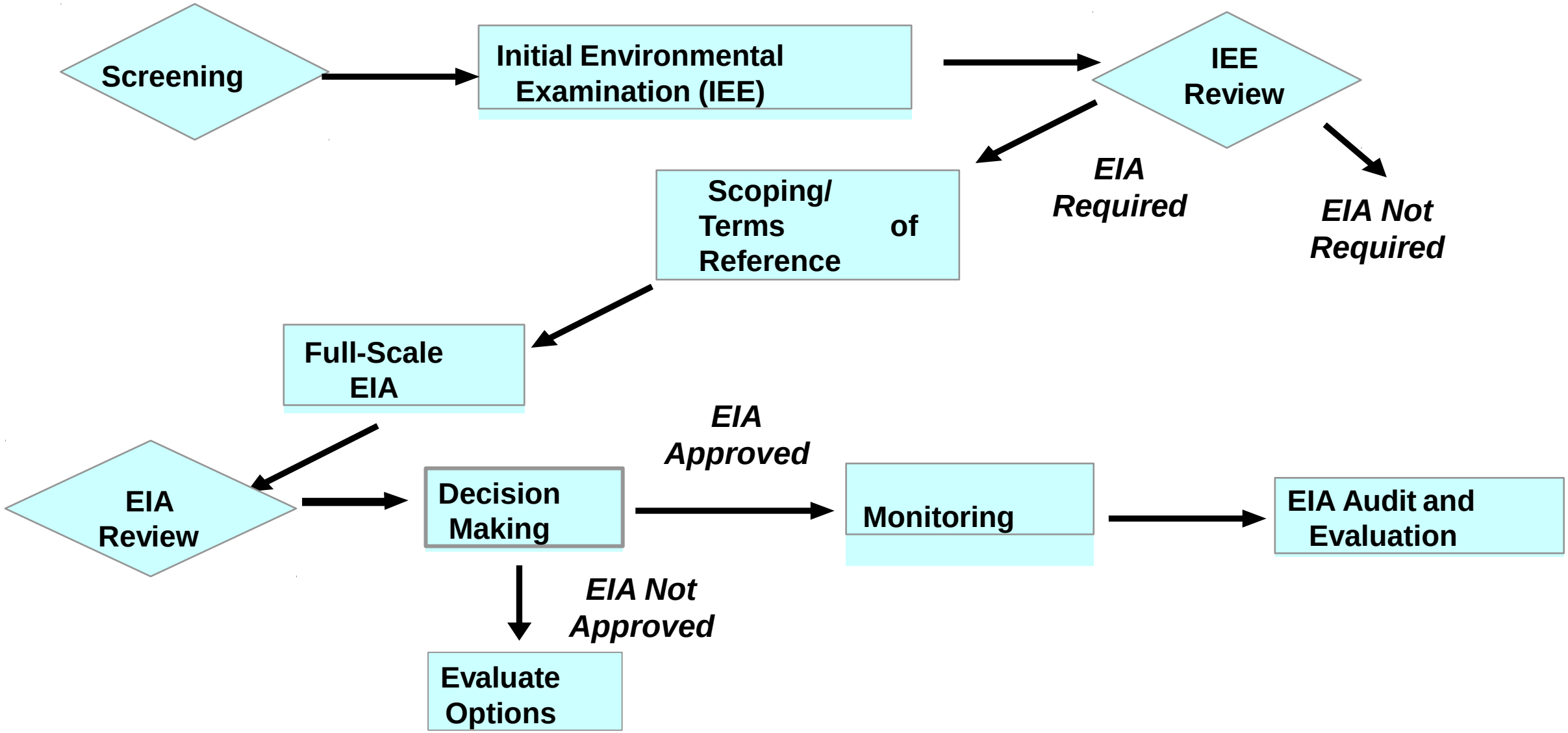
Goals of Environment Impact Assessment

The major aims of EIA are:

- Resources Conservation
- Waste minimization
- Recovery of by-product.
- Efficient use of equipment
- Sustainable Development

PROJECTS UNDERGOING EIA

Flow chart representing the process of EIA



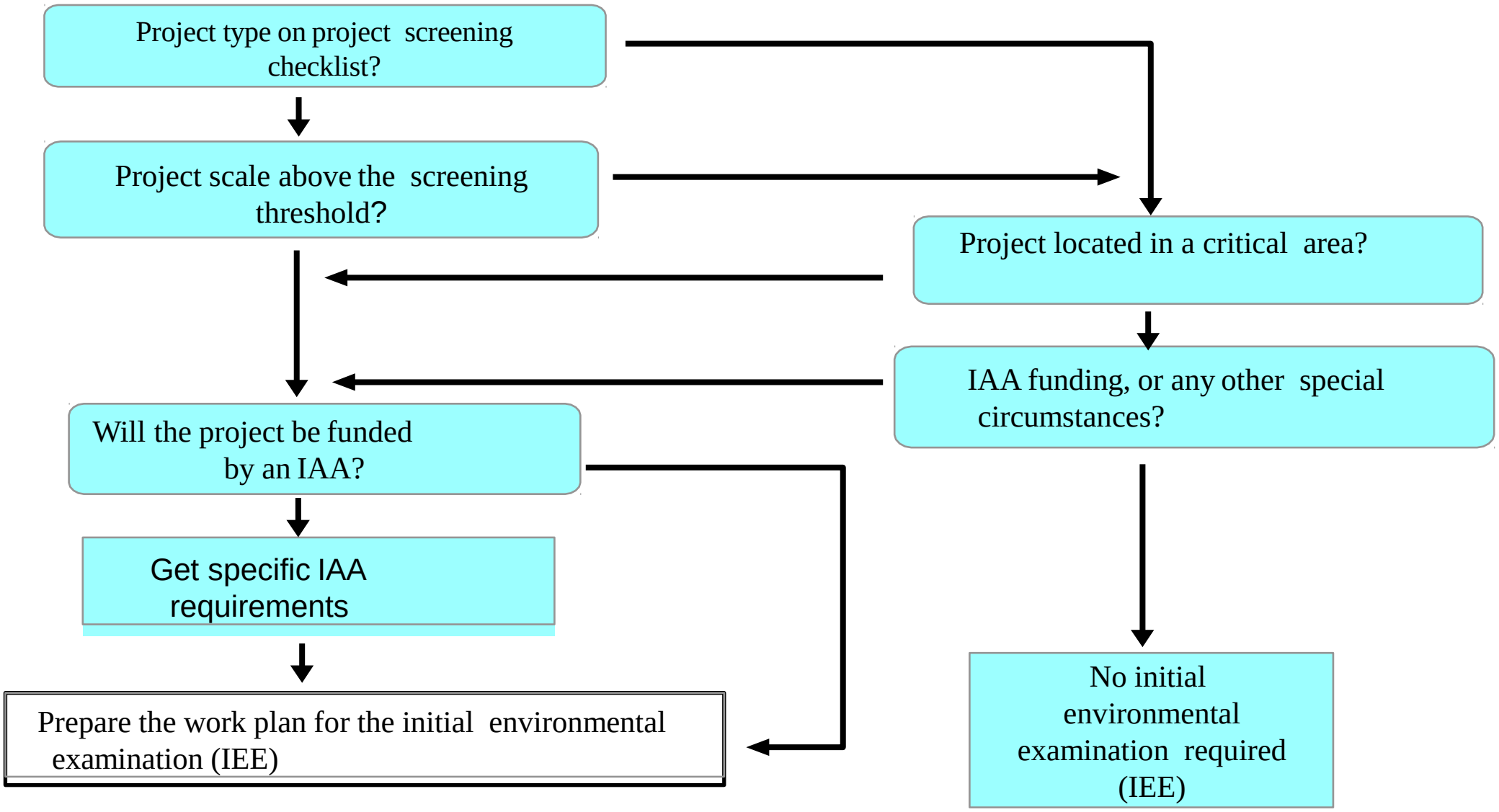
Screening

- It would be time consuming and a, waste of resources for all proposed projects and activities to undergo EIA

- Not all development projects require an EIA, as some projects may not pose an environmental threat

- Screening is the process used to determine whether a proposed project, or activity requires an EIA and, if so, what level of environmental review is necessary.

Screening Flow Chart

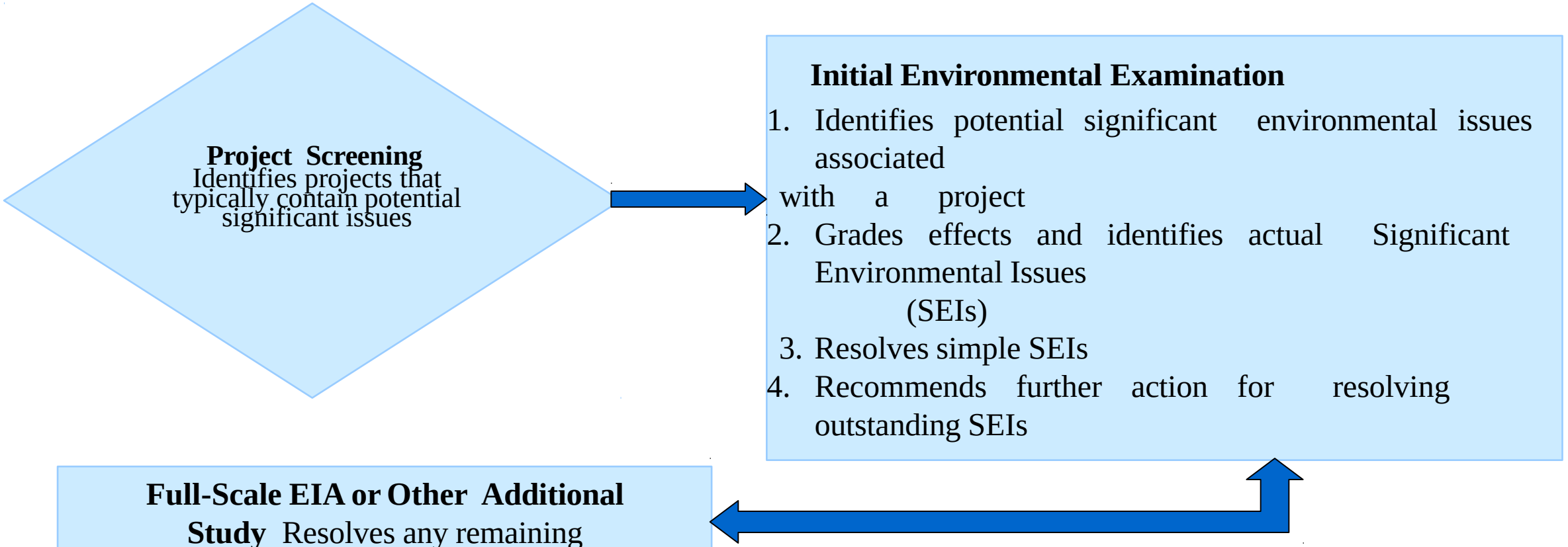


Initial Environment Examination

- Initial environmental examination (IEE) is intended as a low-cost environmental evaluation that makes use of information already available.

- It boost up the process of EIA and lead the matter to further assistance.

IEE in the Overall EIA Process

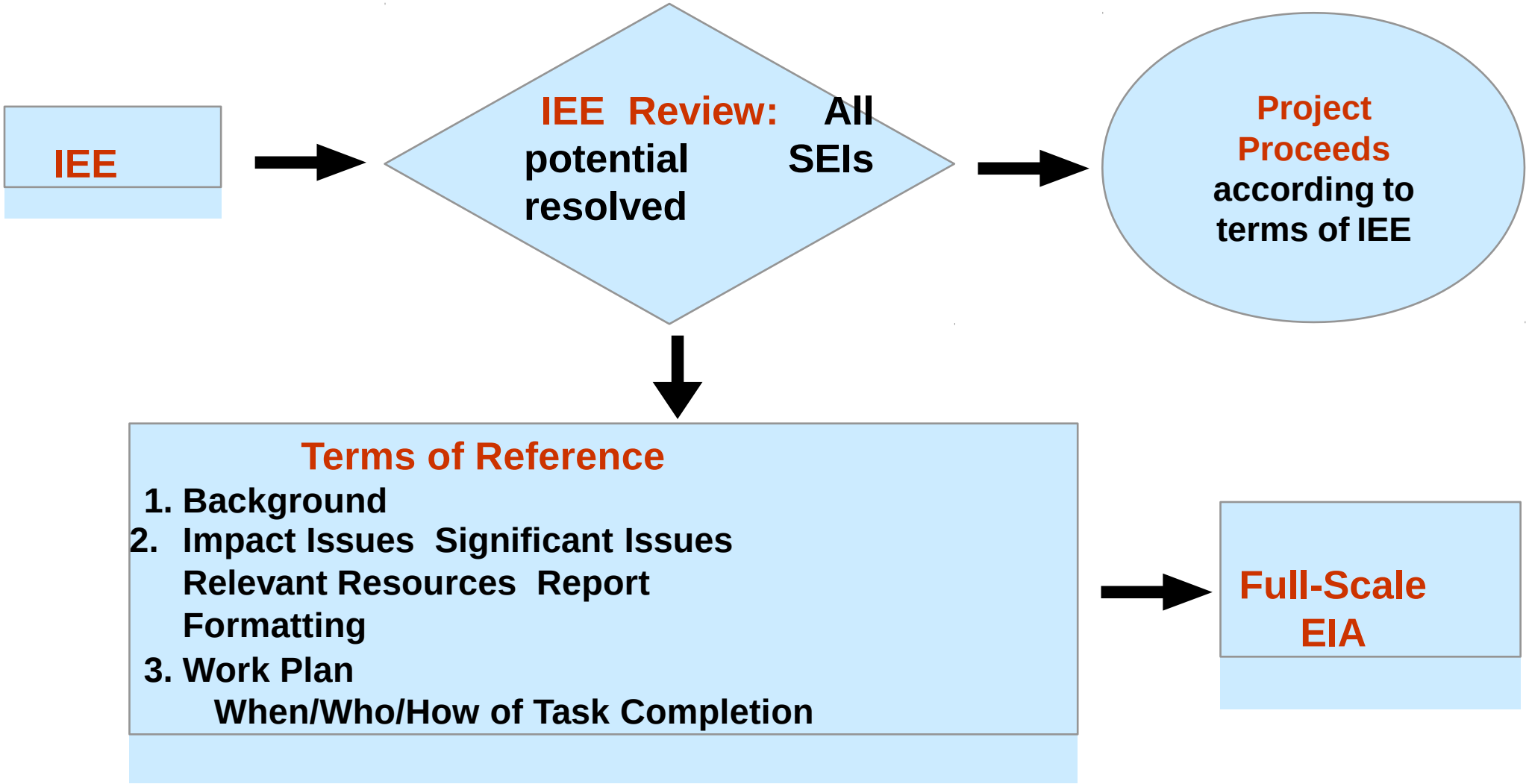


Scoping

- A process of interaction between government agencies and project proponents

- Identifies:
  - spatial and temporal boundaries for the EIA
  - important issues and concern
  - information necessary for decision making
  - significant effects and factors to be considered
  - Establishes terms for reference of full scale EIA

Scoping


IEE
IEE Review: All potential SEIs resolved
Project Proceeds according to terms of IEE
Terms of Reference
1. Background
2. Impact Issues Significant Issues
Relevant Resources Report
Formatting
3. Work Plan
When/Who/How of Task Completion
Full-Scale EIA

Full-Scale EIA Overview

Input = Outstanding SEIs from IEE(initial environment examination).

Assessment phase:

- Qualitative/quantitative analysis of SEI
- SEI impact significance

Mitigation development phase

- Select appropriate mitigation measures
- Residual impact significance

EIA overview

- Checklists
- Matrices
- Risk Assessment
- Network
- Overlays/GIS
- Expert Systems
- Risk assessment

Qualitative

Quantitative

Decision Making

•The challenge of making the final decision on implementing a project is observed.

•Decision are taken at all stages during the EIA process and the outcome will be based on these decisions.

•If a large scale project falls under the jurisdiction of countries with comparable national EIA procedures,it should be feasible to be more ambitious in organising EIA Transboundary.

Monitoring

- In legislation there is a often demand for environmental reporting when treating permits to activities with large EIA.

- This stage involves improvement and mitigational measures to put forward EIA.

- It also involves elements of assessing risks and hazard management.

Audit and Evaluation

- This is the final stage of EIA.
- Audit consists opinions and corrections of the report which are submitted in front of decision making committee.
- It also reveals that whether EIA is necessary or not for the report submitted,if necessary what are the measures taken in order to overcome the drawbacks and hazards.

Uses of EIA

- Systematic evaluation of a eco friendly project.
  - Risk and hazard assessment.
  - Impact identification.
  - Monitoring of impact and advice.
  - Development control
  - Project development
- SEA(strategic environmental assessment) and permit.

CONCLUSION

- EIA is an important tool in assuring that projects and plans will not give adverse impact on the environment.

- The use of EIA has developed throughout the world and may different applications exists.

- EIA process thus could not only prevent costs due to environmental aspects but also prevent possible public opinions and protest against a project.