A hydroelectric power plant harnesses the energy found in moving or still water and converts it into electricity.
Moving water, such as a river or a waterfall, has mechanical energy. ‘Mechanical energy is the energy that is possessed by an object due to its motion or stored energy of position.’ This means that an object has mechanical energy if it’s in motion or has the potential to do work (the movement of matter from one location to another,) based on its position. The energy of motion is called kinetic energy and the stored energy of position is called potential energy. Water has both the ability and the potential to do work. Therefore, water contains mechanical energy (the ability to do work), kinetic energy (in moving water, the energy based on movement), and potential energy (the potential to do work.)
The potential and kinetic/mechanical energy in water is harnessed by creating a system to efficiently process the water and create electricity from it. A hydroelectric power plant has eleven main components. The first component is a dam.

The dam is usually built on a large river that has a drop in elevation, so as to use the forces of gravity to aid in the process of creating electricity. A dam is built to trap water, usually in a valley where there is an existing lake. An artificial storage reservoir is formed by constructing a dam across a river.Notice that the dam is much thicker at the bottom than at the top, because the pressure of the water increases with depth.

The area behind the dam where water is stored is called the reservoir. The water there is called gravitational potential energy. The water is in a stored position above the rest of the dam facility so as to allow gravity to carry the water down to the turbines. Because this higher altitude is different than where the water would naturally be, the water is considered to be at an altered equilibrium. This results in gravitational potential energy, or, “the stored energy of position possessed by an object.” The water has the potential to do work because of the position it is in (above the turbines, in this case.)

Gravity will force the water to fall to a lower position through the intake and the control gate. They are built on the inside of the dam. When the gate is opened, the water from the reservoir goes through the intake and becomes translational kinetic energy as it falls through the next main part of the system: the penstock. Translational kinetic energy is the energy due to motion from one location to another. The water is falling (moving) from the reservoir towards the turbines through the penstock.

The intake shown in figure includes the head works which are the structures at the intake of conduits,tunnels or flumes.These structures include blooms,screens or trash - racks, sluices to divert and prevent entry of debris and ice in to the turbines.Booms prevent the ice and floating logs from going in to the intake by diverting them to a bypass chute.Screens or trash-racks(shown in fig) are fitted irectly at the intake to prevent the debris from going in to the take.Debris cleaning devices should also be fitted on the trash-racks.Intake structures can be classified in to high pressure intakes used in case of large storage reservoirs and low pressure intakes used in case of small ponds.The use of providing these structures at the intake is,water only enters and flows through the penstock which strikes the turbine.
Control gates arrangement is provided with Spillways.Spillway is constructed to act as a safety valve.It dischargs the overflow water to the down stream side when the reservoir is full.These are generally constructed of concrete and provided with water discharge opening,shut off by metal control gates.By changing the degree to which the gates are opened,the discharge of the head water to the tail race can be regulated inorder to maintain water level in reservoir.
The penstock is a long shaft that carries the water towards the turbines where the kinetic energy becomes mechanical energy. The force of the water is used to turn the turbines that turn the generator shaft. The turning of this shaft is known as rotational kinetic energy because the energy of the moving water is used to rotate the generator shaft. The work that is done by the water to turn the turbines is mechanical energy. This energy powers the generators, which are very important parts of the hydroelectric power plant; they convert the energy of water into electricity. Most plants contain several generators to maximize electricity production.
The generators are comprised of four basic components: the shaft, the excitor, the rotor, and the stator. The turning of the turbines powers the excitor to send an electrical current to the rotor. The rotor is a series of large electromagnets that spins inside a tightly wound coil of copper wire, called the stator. “A voltage is induced in the moving conductors by an effect called electromagnetic induction.” The electromagnetic induction caused by the spinning electromagnets inside the wires causes electrons to move, creating electricity. The kinetic/mechanical energy in the spinning turbines turns into electrical energy as the generators function.
The transformer, another component, takes the alternating current and converts it into higher-voltage current. The electrical current generated in the generators is sent to a wire coil in the transformer. This is electrical energy. Another coil is located very close to first one and the fluctuating magnetic field in the first coil will cut through the air to the second coil without the current. The amount of turns in the second coil is proportional to the amount of voltage that is created. If there are twice as many turns on the second coil as there are on the first one, the voltage produced will be twice as much as that on the first coil. This transference of electrical current is electrical energy. It goes from the generators to one coil, and then is transferred through an electromagnetic field onto the second coil. That current is then sent by means of power lines to the public as electricity
Now, the water that turned the turbines flows through the pipelines (translational kinetic energy, because the energy in the water is being moved,) called tailraces and enters the river through the outflow. The water is back to being kinetic/mechanical/potential energy as it is in the river and has to potential to have the energy harnessed for use as it flows along (movement.)