- If $\mathbf{k < 1}$, **Then** $\mathbf{E_s < E_p}$, transformer is ***Step Down.***

Also, for step down transformer $\boldsymbol{N_p > N_s}$, and for step up transformer $\boldsymbol{N_P < N_s}$.

Let the currents in the primary and the secondary coils be I_P and I_s respectively. Then, input power and output power are

$$Input\ power = E_P I_P$$

$$Output\ power = E_s I_s$$

If we assume that there is no loss of power then this transformer is called ideal transformer for which we can write,

$$Input\ power = Output\ power$$

$$E_P I_P = E_s I_s$$

$$\frac{\boldsymbol{E_s}}{\boldsymbol{E_P}} = \frac{\boldsymbol{I_p}}{\boldsymbol{I_s}} - - - - - (\mathbf{4})$$

Therefore, $$\boldsymbol{E \propto \frac{1}{I}} - - - - - - - - - (\mathbf{5})$$

Thus, the transformer increases voltage by decreasing current and vice-versa.

Efficiency of transformer:

The efficiency of transformer is defined as the ratio of output power to the input power in a transformer is called its efficiency. It is denoted by η.

i.e. $$Efficiency\ (\eta) = \frac{Output\ Power}{Input\ Power} \times 100\%$$

In an ideal transformer, where there is no loss of energy, the efficiency is 100%. But the efficiency of the entire practical transformer is less than 100% due to different types of energy loss in transformer.

Energy Loss in Transformer:

There are several types of energy loss in transformers which are explained as follows.

Copper loss: When electric current passes through the copper coil of the transformer, power is lost in the form of heat ($H = I^2Rt$) due to the resistance of the copper coil. This causes a waste of energy and reduces the efficiency of the transformer. To minimize the copper loss thicker wire can be used to make the coil of the transformer.

Flux loss (flux leakage): The magnetic flux produced due to the flow of current in the primary coil may not be perfectly coupled to the secondary coil. The loss of energy due to leakage of flux or imperfect coupling of flux between the primary and secondary coil is called flux loss. This also reduces the efficiency of transformer.