Acoustic Energy & Acoustic Power in Sound Waves

In order to create an acoustic "disturbance' in a medium (gas, liquid, solid..), must input/expend energy. The energy supplied to create the acoustic wave travels with the wave as it propagates.

Process whereby acoustic energy is carried away from the sound source is called RADIATION.

In order to make a sound source radiate, *e.g.* a constant over-pressure amplitude sound wave requires a certain amount of energy input per unit time into the sound source – *i.e.* power, $P(t)$:

$$\text{Power, } P(t) = \frac{\Delta E(t)}{\Delta t} = \frac{\partial E(t)}{\partial t} = \text{time rate of change in energy} = \textit{Joules/second} = \textit{Watts}$$

The sound source then radiates sound energy; the acoustic power in the sound wave is expressed in acoustic Watts.

TABLE II
Measured greatest power outputs of some musical instruments

	POWER OUTPUT, WATTS
Large orchestra	67
Bass drum	25
Snare drum	12
Cymbals	9.5
Trombone	6.4
Piano	0.44
Trumpet	0.31
Tuba	0.20
Double bass	0.16
Flute	0.055
French horn	0.053
Clarinet	0.050

Electrical (and/or mechanical) power input to the sound source = power supplied (Watts)

Note that the efficiency for conversion of *e.g.* electrical power into acoustical power, *e.g.* using a loudspeaker is not very high:

$$\text{Efficiency} \equiv \frac{\text{acoustic power}}{\text{power supplied}} \sim \text{1-2\%} \Leftarrow \text{ typical efficiency for loudspeakers!}$$

Thus, *e.g.* for a 100 Watt (rms) guitar amplifier, the power rating of the amplifier actually refers to the ***electrical*** power driving the loudspeaker(s) of the amp; the actual ***acoustic*** power radiated by loudspeakers of the 100 Watt (rms) guitar amplifier is typically only ~ 1-2 acoustic Watts (rms)!