



## Weird & Wireless: How did we end up with a kilowatt-hour?

*Welcome again to the wonderful but sometimes weird world of wireless comms, written by Joel Young, [CTO of Digi International](#)*

How did we ever end up with something called a kilowatt-hour? The kilowatt-hour has always been, at least for me, one of the more puzzling of all the units of energy.

I know, for many of us we are continually embroiled in the metric vs. imperial system debate, this is a debate that I understand - miles vs. kilometres for example, both seem reasonably arbitrary for me.

However, the kilowatt-hour is an abomination, created by someone who forgot what they learned in physics. Ever since we changed our first light bulb, we have been familiar with the almighty watt. We might not have completely understood the nuances of the watt, but it didn't take us long to figure out that light bulbs with more watts, are brighter and hotter. The bill payers in our house were noticeably irritated when we left the lights with big watt numbers turned on.

Returning to our elementary physics class, we of course remember that in electrical terms a watt is equal to potential (measured in volts) x current (measured in amperes). And of course, current is really the amount of charge that moves each second.

Hence, one ampere equals the movement of one coulomb (unit of charge) per second. So, a watt is really equal to 1 volt-coulomb per second. Most of us familiar with units of energy will no doubt remember that 1 volt-coulomb is the same as 1 joule - the metric unit of energy. Still with me?

Well, for those of you that I lost, let's return to the notion of power - not power in the purely electrical sense, but power or the sake of getting work done. Power is the application of energy per unit of time - most notably the second. Note that you really can't get any work done with power itself unless you apply power over a length of time. In the old imperial system of measurement that most of us are familiar with is the horsepower.

Ironically enough, the horsepower as a unit of power was invented by Scottish inventor James Watt when he was looking for a way to describe the power in his steam engines, the name sake of the metric equivalent: 1 hp = 745.56 watts. So, when you apply power for a period of time, you use energy. It doesn't actually matter whether your power comes from steam, gasoline or electricity. In order to get any work done (energy), you need to apply power for some time.

So, if I use power over a period of time, I consume energy. Remember that energy is measured in joules - which is the use of one watt for one second. If I turn a 60 watt light-bulb on for 60 seconds, I've used 60 joules of energy.

So what's up with the Kilowatt-hour?

Well, it turns out that those who originally put in our electric metrology forgot all about their physics class or thought the notion of joules was too complicated. So they invented a brand new energy measure instead. One kilowatt-hour is the use of 1000 watts for 1 hour, or rather 1000 joules/second for 3600 seconds or rather 3.6 mega joules. So we should be paying for our electricity by the mega joule instead of the kilowatt-hour.

Of course, if we really wanted to return to the old imperial system of units (as created by James Watt), then we should be measuring electricity by the horsepower-minute. Since 1 hp = 745.56 watts, 1 kilowatt-hour would be  $60 \times 1000 / 745.56$  or 80.5 horsepower-minutes. Wouldn't that be fun?

I fully expect that most readers will be puzzled by my nerdy rant. To that I offer the following thought. What would you say, if after completing a long car road trip, the driver said, "Well it looks like we travelled 60 miles-per-hour-days"? You were expecting 1,440 miles?

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