Power and Energy

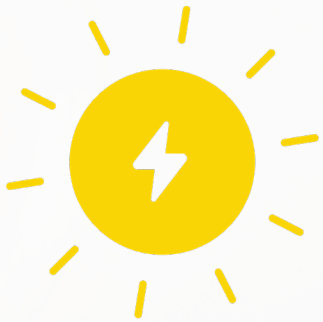
Today, with so much interest in electricity, whether it be via household solar systems or more recently electric vehicles (EV's), the confusion between power and energy, is understandable. Here, hopefully, we can sort out the confusion.

Power
is that force which moves vehicles, heats our water, powers our electronic devices and so on.

Energy
is the result of that force acting over time which is the work done.

Keeping in the electrical domain, power has the units, in the metric system, of watts (W), thousands of watts (kW), millions of watts, megawatts (MW) and so on. In electric vehicles, electrical power from the battery produces that force which propels the vehicle down the road. Interestingly to go twice as fast we need to provide eight times as much power to overcome the aerodynamic drag of the vehicle moving through the air.

The result of that application of electrical power over time to move the vehicle, i.e. work done is called energy which is the electrical power applied multiplied by the time for which that power is applied.



Moving to an example with heating water. We heat a 2 litre jug of water from 20 degrees centigrade to boiling point at 100 degrees centigrade. The jug has a heating element that dissipates or consumes 2 kW of power. The water will take 5 minutes to heat to boiling point and will consume 190 Wh or 0.19 kWh of energy. The work done in heating the water is 0.19 kWh of energy.

Let us expand the water heating example to the home hot water system heated by a conventional heating element with a power rating of 3.6 kW. Let's use a tank with a volume of 250 litres, a starting water temperature of 20 degrees centigrade and a final temperature of 70 degrees centigrade. The heating process will take 4 hours and 2 minutes and consume 14.52 kWh of electrical energy. Saying this another way, the application of that electrical force or pressure of 3.6 kW for a time of 4 hr 2min consumes 14.52 kWh of energy.

4 hr 2 min = 4.033hr

3.6 kW x 4.033 hr =14.52 kWh
1.8 kW x 8.066 hr =14.52 kWh

If we applied only half of that 3.6 kW of electrical power it would take double the time but consume the same amount of energy. The total work done heating the 250 litres of water through 50 centigrade degrees (70 – 20 = 50) is the same in both cases. It just happens twice as quickly in the first case. From all of this we can see that power is the rate of doing work; work is energy. Heat that same volume of water to the same target temperature faster i.e. deliver that same energy faster and you will require more power.

A final point. That 14.52kWh required to heat the water in our hot water tank is quite a lot of energy; enough to drive our Tesla model 3 for about 100 km. And at a cost of around 16 cents/kWh in the middle of the night will amount to $2.38 (16 x 14.52 = 2.38). Even allowing for the fact that we usually don't start with a cold tank every day the water heating costs for Australian households is considerable.

For more info about anything **Solar, Battery, and Electrical,** visit out website at **www.elitepowergroup.com.au**