



## **Kilojoules (kJ) versus Kilocalories (kCal): What's the Difference?**

*By Colin Sandberg, Cadence Cycling & Multisport Centers, Philadelphia*

It seems that there is a common misconception that a power meter is capable of telling you how many Calories you burn in a workout. Something I hear all the time from athletes is, "That was a really hard ride... I burned 3300 Calories. To that I reply, "How do you know you burned 3300 Calories?" The answer is inevitable: "Well, because that's what it says on my PowerTap (under 'e')"

In truth, this number refers to the amount of work you did on your ride (measured in kilojoules or kJ), not the Calories (kCal) you burned. I believe that the reason this misconception exists is because under steady state conditions, a very efficient rider will burn approximately the same number of kCal as kJ. But don't make the mistake of thinking that they are the same thing.

First, let's take a step back to 8th grade physics class. Work is a measure of energy transfer, calculated as Force x Distance. It requires a given amount of work to move an object from one place to another. You can think of moving a pile of bricks from one side of the room to another, walking up a set of stairs, or riding your bike up a hill. Work is not time dependant so whether you do the work fast or slow, the work required does not change.

Power is calculated as Force x Velocity (or Energy/time). So, extrapolating, Energy = Power x Time. What this means is that if I move the bricks faster, run up the stairs and sprint up the hill the power is greater and the time is lower. If I move the bricks slowly... walk slowly up the stairs... ride slowly up the hill... the power is lower and the time is greater. Either way it's the same amount of work.

A Calorie is also a unit of energy, but when we talk about Calories in this context we are usually referring to the amount of energy the body is burning. The conversion from kJ to kCal is 4.184 to 1. So in reality, if you do a 3300 kJ ride, this is only equivalent to 789 kCal. However, this makes the assumption that every Calorie your body burns actually goes into work done on the bike, which is incorrect. In fact, only 1 out of every 4-6 Calories you burn goes into this work. So what happens to the other 75-85% of the Calories? Some are used to support vital body functions, but the majority are lost in heat. And of course, all that heat produced means that your body has to work even harder (and thereby burn more Calories) to cool itself off.

This is where metabolic efficiency comes into play. An efficient pro cyclist on a steady endurance ride is probably close to the 25% efficiency mark (meaning that 1 out of 4 of their

Calories ends up helping to move the bike forward). So although 3300 kJ is only equal to 789 kCal, 25% efficiency would mean that that this rider burns 3156 kCal during this effort. A less efficient rider or a rider completing a more variable effort (e.g. race, group ride, etc.) will be closer to 18% efficiency (1 out of every 5.6 kCal goes into moving the bike forward) so this rider would burn 4383 kCal for the same 3300 kJ ride.

Now before you go start getting depressed about being so inefficient, think about this: a 165 pound cyclist (me, to be specific) generally does about 35-40 kJ of work per mile. Let us assume that I have a metabolic efficiency of 23%. This means that I burn 36- 42 kCal per mile. A Toyota Prius hybrid gets about 38 miles per gallon. About 159,000 kJ are stored in a gallon of gasoline (37,975 kCal) so it requires 999 kCal to go 1 mile. This means that when I ride my bike I am 24-28 times *more* efficient than a Prius, or alternatively, for a car to be as efficient as a bicycle, it would have to get 784-912 miles per gallon. Think about that the next time you are thinking about ways to go green!