

What is a power meter?

A power meter is a device that we use on our bikes to help us determine how much power we are generating as we turn the pedals on our bikes. There are many different types of power meters.

They can be:

1) Hub based



2) Crank based



3) Pedal based



4) Spider based



What is a Watt?

A power meter simply is a device that has ***strain gauges*** inside...and when they are bent...due to some force...tension in the form of watts is transmitted to a bike computer for us to look at



What is a Watt?

Here are some equations:

$$\text{Power} = \text{Work} / \text{time}$$

Power is the *rate* at which work is done and the standard metric unit of power is a **Watt**

$$\text{Work} = \text{Force} \times \text{Distance}$$

$$\text{Power} = (\text{Force} \times \text{Distance}) / \text{time}$$

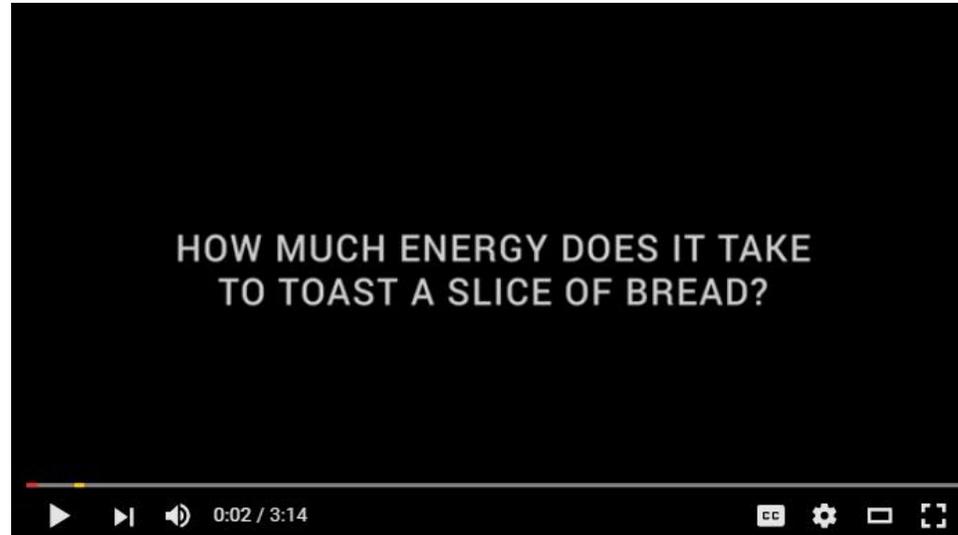
Force = torque to do work

Distance = size of wheel or crank



How much power do you need?

Here is a fun video showing how much energy is needed to toast a slice of bread (700W Toaster)



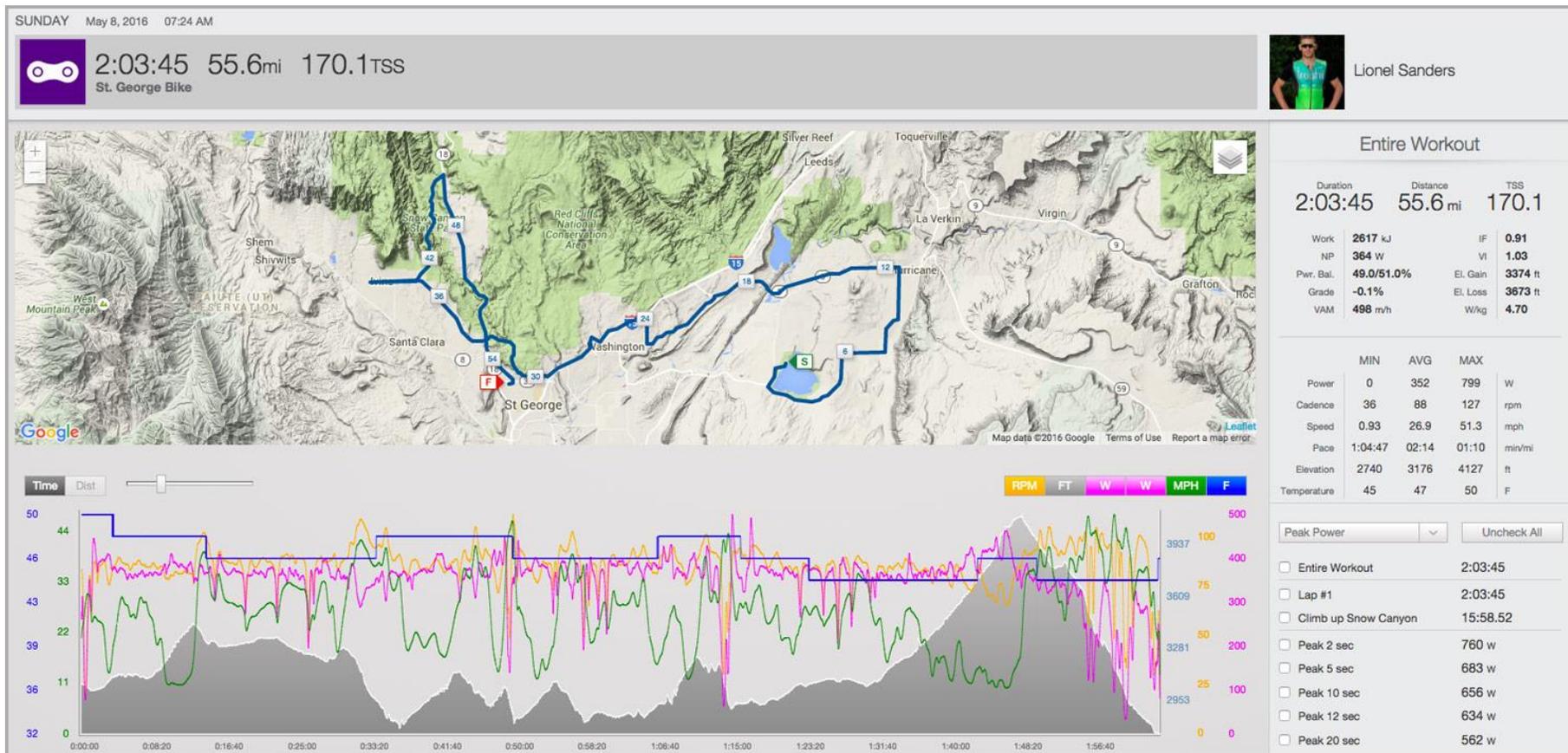
Click the link below to watch the video

<https://www.youtube.com/watch?v=S4O5voOCqAQ>

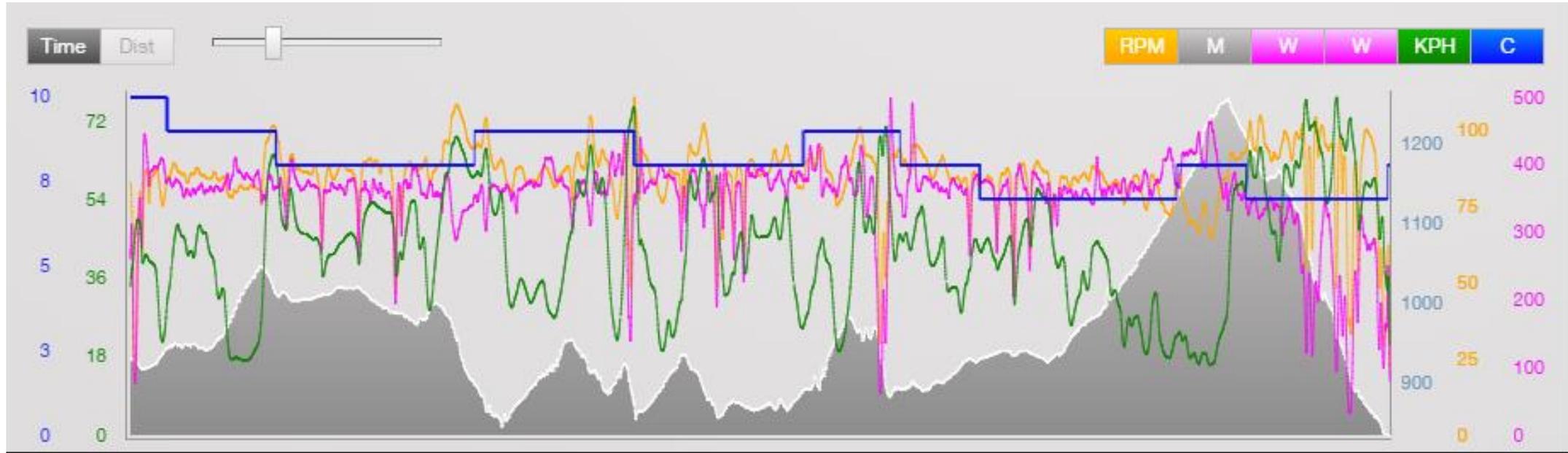


What are all these metrics?

Every now and then TP will send out emails or post on their blog race results from a top pro for us to analyze. For example here is Lionel Sanders power file.



What are all these metrics?



Entire Workout			
Duration	Distance	TSS	
2:03:45	89.4 km	170.1	
Work	2617 kJ	IF	0.91
NP	364 W	VI	1.03
Pwr. Bal.	49.0/51.0%	El. Gain	1028 m
Grade	-0.1%	El. Loss	1119 m
VAM	498 m/h	W/kg	4.70

	MIN	AVG	MAX	
Power	0	352	799	W
Cadence	36	88	127	rpm
Speed	1.49	43.4	82.5	kph
Pace	40:15	01:23	00:44	min/km
Elevation	835	968	1258	m
Temperature	7	8	10	C



What is a Metric?

A metric is simply something that is measured.

What are the important metrics needed when training with power?

1. Functional Threshold (FTP)
2. Average Power (AP)
3. Normalized Power (NP)
4. Variability Index (VI)
5. Intensity Factor (IF)
6. Training Stress Score (TSS)
7. Watts per Kilogram (W/Kg)



Power Metrics

1. Functional Threshold Power (FTP)

- this is one of the most important metrics we will measure
- also known as Lactate Threshold (LT) power
- is the maximum power a cyclist can hold for one hour (Hour Power)
- is something that I have my athletes test on a regular basis
- typical FTP tests are 20 or 30 min in length (as hard as you can go)
- once FTP is known we can calculate training zones (power and HR)

Power Metrics

2. Average Power (AP)

- Is the average power for your entire bike ride
- This will include zeros
- Make sure your turn off non zero averaging on your computer so you can get an accurate average value

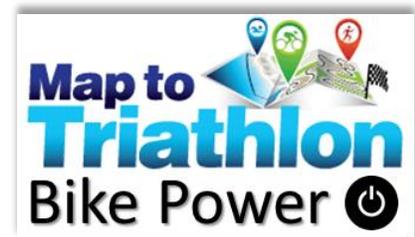


Why so bouncy?

When you first start using your power meter you will find that the values do not seem very steady at all.

With the ever changing elements of being outside such as grade (elevation) and wind that your numbers seem to be constantly changing.

This constant change tends to make the average power a poor indicator of how hard your ride actually was.



Power Metrics

3. Normalized Power (NP)

Is an estimate of the power you could have held for the same effort if your power output was steady rather than fluctuating

NP is always higher than AP

NP is a better indicator than AP for how hard the workout was

e.g. If you pedal at 200W for 1 hour.....NP and AP will **both equal 200W**

If you pedal at 100W for 20 min, 200W for 20 min, and 300W for 20 min

Your **AP will be 200** but **NP will be 239 W**



Power Metrics

4. Variability Index (VI)

Describes how smooth or variable your effort was during the ride

$$VI = NP / AP$$

A triathlon is usually a race with a steady effort and **VI ~ 1.05**

A cycling race on the other hand can have lots of drafting, surges and sprints that result in **VI ~1.2** or higher

The more surges you have in a race the higher your NP and thus higher VI
When your NP and AP are similar in value, this will lead to a smoother power output and your VI being close to 1.0

For an Ironman event Joe Friel suggests a **VI of 1.06**
or less (smooth pacing)



Power Metrics

5. Intensity Factor (IF)

Tells you **how hard**

$$\text{IF} = \text{NP} / \text{FTP}$$

E.g. (early season) if NP is 210 W and your FTP is 280 W your IF = $210/280 = 0.75$

(race season) if NP is 210 W and your FTP is 300 W your IF = $210/300 = 0.70$

IF Examples:

Values less than 0.75 = Easy recovery rides

Values 0.75 – 0.85 = LSD (Long Steady Distance) rides

Values 0.85 – 0.95 = threshold workouts, 40Km TT

Values higher than this would be for short high intense bike workouts or short races (less than 15Km)



Power Metrics

6. Training Stress Score (TSS)

This is a number that is assigned to each workout that represents the stress it took on your body

An all out effort in biking will result in a TSS score of 100.

You can't accumulate more than 100 points in an hour

TSS when measured over time can be very useful in determining your fitness and fatigue (we will see in the PMC later)

$$\text{TSS} = (\text{IF}^2 \times \text{workout time \{in hours\}} \times 100)$$



Power Metrics

7. Watts per Kilogram (W/Kg)

Is more important than simply Watts

E.g. say two riders have the same FTP of 250 Watts. One rider weighs 60 Kg and the other weighs 90 Kg.

The lighter rider will be able to ride faster than the heavier rider

There are three ways to get faster

- 1) Increase more power
- 2) Lose weight or
- 3) Increase power and lose weight

