# Team Pursuit strategy modelling task

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* Energy re-distribution model
  + General concept: more power for less time or vice-versa
  + The part of the power that gets scaled with time is the over-threshold part
  + The over-threshold energy bucket is known as W’
  + See below:

Incorrect:

Energy 2 = Energy 1

Power >>

Energy 1

Power >

Time >

Time >>

Correct – re-distribute only the over-threshold part of the energy:

Over threshold energy 2 = OTE 1

Over threshold energy 1

Sub threshold Energy 1

STE 2 ≠ STE 1

Power >

Power >

Time >

Time >>

* + When a rider drops below their defined threshold power, the energy in the W’ bucket is replenished at a J/sec rate
  + This recovery rate in reality is specific to the athlete but for pragmatic purposes we will use the empirically derived coefficient from study by Bartram – see attached pdf
    - It is typical that no rider goes much below their threshold during a team pursuit i.e. they deplete their W’ throughout the event, just at a greater or lesser rate. Nonetheless some smaller, high aerobic capacity riders do achieve this and so we should include it in the supply model
* Approach
  + Specify lap 1 time
    - Use historical lap 1 power profile
    - Iteratively scale the lap 1 power until desired lap 1 time is achieved
    - Gives terminal velocity at end of lap one
  + Subsequent lap split initial value based on terminal velocity of lap 1 – constant
    - Implicitly drives powers for each position
  + Specify turn order, number of turns and initial durations
    - For the optimisation run, turn order and number of turns shall remain fixed
      * Matrix of these can be defined manually
        + 4x riders
        + 1, 2 or 3 turns
    - Turn duration will be that which is optimised
  + Run forward integration model;
    - If all four riders can get to the end, decrease lap splits (i.e. go faster) until only 3 can finish
      * Be sure to also increase lap 1 power to match new terminal velocity requirement
    - Once only three riders can finish, note relative W’ remaining across the 3
    - Continue to increase speed until 3 riders cannot finish
    - At this point, re-distribute turn durations based on W’ proportions
    - Continue to increase speed until 3 riders cannot finish
  + Manually / automatically cycle through alternative TP configs
    - Manual will be fine for the short-term
* Inputs
  + Use over threshold energy from past data
  + Threshold power values for each athlete
  + Use highest O-T energy from any ride as potential available for each athlete
  + Use best ride average CDA from any ride for each athlete
  + Initial turn strategy
  + Other typical model inputs
    - Air density
    - Tyre rolling resistance parameters
    - Total mass
    - Seat height
    - Track shape parameters
* Outcomes
  + Fastest time possible, through varying turn duration for a given TP configuration of
    - Rider order, number of turns for each rider
  + Implicit assumptions
    - Constant lap splits once up to speed