Power

This section covers many complex calculations, using best-estimate data. The purpose is to consider the range of issues and challenges, rather than suggest definite solutions.

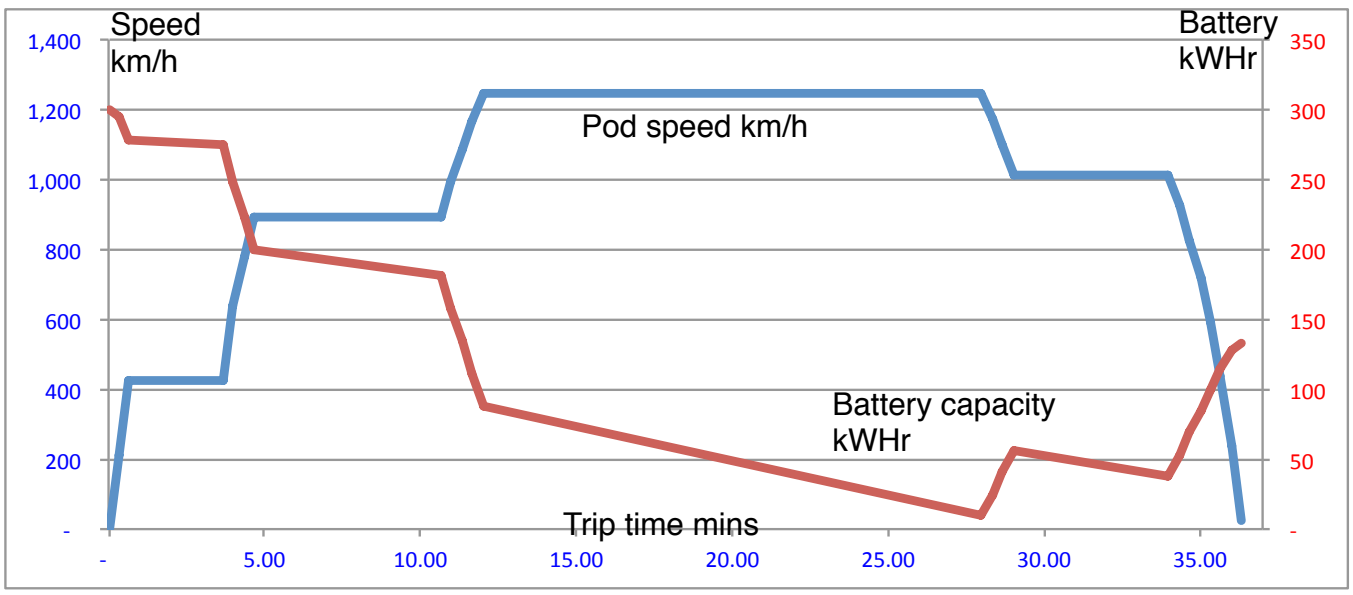
Traction power options

Traction for Hyperloop can either be powered from the track, or powered from the pod itself. Alpha proposed linear motors, powered from the track, which reduced the power requirements of the pod, but increased the capital costs of the expensive copper coils for the linear motor sections.

Capital expense is saved if the pod provides the traction power, using wheels or linear motors with the copper coils on the pod. But considerable power is required for the high-speed acceleration, and this needs to be stored in batteries, possibly charged from electrical pickups to rails in the tube.

Power using lithium ion batteries

The graph below shows the battery power for a trip similar to LA to San Francisco. The blue line shows the speed, it increases in 3 stages to the full speed of 1,200 km/h, then slows in 2 stages at the end. The pod is 10,000 kg, the trip distance is 600 km, the wheels have a lift/drag ratio of 200. The battery capacity is 300 kWh, weighing about 1,500 kg. (The Tesla Model S has 85 kWh). It can be seen that the battery size is needed to provide the acceleration to full speed, and part of that is regenerated as the pod slows for the end station. The battery has about 45% charge by the end of the trip.



Energy loss with acceleration and regenerative braking

The high speed of Hyperloop required considerable energy to reach full speed, and not all of that is returned during braking. The graph assumes a 10% loss during acceleration and braking, so a full cycle costs 20% of the energy. It can be seen that a trip with a number of accelerators from low to full speed would increase the energy cost for the trip.

Super-capacitors

Cheetah requires 3,500 kW of peak power for acceleration, this requires at least 200 kWh of lithium ion batteries. It is possible to use super-capacitors for the peak power, which can charge and discharge at a high rate. The use lithium batteries for the average power.

Possible power pickup

It is possible to have power tracks in the tube, and have a pair of pickups on the pod. The pickups would input the average power for the whole trip, i.e. about 320 kW, and use the batteries or super-capacitors to provide the peak 3,500 kW for the acceleration.