ADVANTAGES

Energy use

Energy for maglev trains is used to accelerate the train. Energy may be regained when the train slows down via regenerative braking. It also levitates and stabilises the train's movement. Most of the energy is needed to overcome "air drag". Some energy is used for air conditioning, heating, lighting and other miscellany.

At low speeds the percentage of power used for levitation can be significant, consuming up to 15% more power than a subway or light rail service. For short distances the energy used for acceleration might be considerable.

The power used to overcome air drag increases with the cube of the velocity and hence dominates at high speed. The energy needed per unit distance increases by the square of the velocity and the time decreases linearly. For example, 2.5 times more power is needed to travel at 400 km/h than 300 km/h.

Comparison with conventional trains

Maglev transport is non-contact and electric powered. It relies less or not at all on the wheels, bearings and axles common to wheeled rail systems.

•**Speed:** Maglev allows higher top speeds than conventional rail, but experimental wheel-based high-speed trains have demonstrated similar speeds.

•**Maintenance**: Maglev trains currently in operation have demonstrated the need for minimal guideway maintenance. Vehicle maintenance is also minimal (based on hours of operation, rather than on speed or distance traveled). Traditional rail is subject to mechanical wear and tear that increases exponentially with speed, also increasing maintenance.

•**Weather**: Maglev trains are little affected by snow, ice, severe cold, rain or high winds. However, they have not operated in the wide range of conditions that traditional friction-based rail systems have operated. Maglev vehicles accelerate and decelerate faster than mechanical systems regardless of the slickness of the guideway or the slope of the grade because they are non-contact systems.

•**Track**: Maglev trains are not compatible with conventional track, and therefore require custom infrastructure for their entire route. By contrast conventional high-speed trains such as the TGV are able to run, albeit at reduced speeds, on existing rail infrastructure, thus reducing expenditure where new infrastructure would be particularly expensive (such as the final approaches to city terminals), or on extensions where traffic does not justify new infrastructure. John Harding, former chief maglev scientist at the Federal Railroad Administration, claimed that separate maglev infrastructure more than pays for itself with higher levels of all-weather operational availability and nominal maintenance costs. These claims have yet to be proven in an intense operational setting and does not consider the increased maglev construction costs.

•**Efficiency**: Conventional rail is probably more efficient at lower speeds. But due to the lack of physical contact between the track and the vehicle, maglev trains experience no rolling resistance, leaving only air resistance and electromagnetic drag, potentially improving power efficiency.Some systems however such as theCentral Japan Railway Company SCMaglev use rubber tires at low speeds, reducing efficiency gains.

•**Weight**: The electromagnets in many EMS and EDS designs require between 1 and 2 kilowatts per ton. The use of superconductor magnets can reduce the electromagnets' energy consumption. A 50-ton Transrapid maglev vehicle can lift an additional 20 tons, for a total of 70 tons, which consumes 70-140 kW.Most energy use for the TRI is for propulsion and overcoming air resistance at speeds over 100 mph.

•**Weight loading**: High speed rail requires more support and construction for its concentrated wheel loading. Maglev cars are lighter and distribute weight more evenly.

•**Noise**: Because the major source of noise of a maglev train comes from displaced air rather than from wheels touching rails, maglev trains produce less noise than a conventional train at equivalent speeds. However, the psychoacoustic profile of the maglev may reduce this benefit: a study concluded that maglev noise should be rated like road traffic, while conventional trains experience a 5–10 dB "bonus", as they are found less annoying at the same loudness level.

•**Braking**: Braking and overhead wire wear have caused problems for the Fastech 360 rail Shinkansen. Maglev would eliminate these issues.

•**Magnet reliability:** At higher temperatures magnets may fail. New alloys and manufacturing techniques have addressed this issue.

•**Control systems**: No signalling systems are needed for high-speed rail, because such systems are computer controlled. Human operators cannot react fast enough to manage high-speed trains. High speed systems require dedicated rights of way and are usually elevated. Two maglev system microwave towers are in constant contact with trains. There is no need for train whistles or horns, either.

•**Terrain**: Maglevs are able to ascend higher grades, offering more routing flexibility and reduced tunneling.

Comparison with aircraft

Differences between airplane and maglev travel:

•**Efficiency**: For maglev systems the lift-to-drag ratio can exceed that of aircraft (for example Inductrack can approach 200:1 at high speed, far higher than any aircraft). This can make maglev more efficient per kilometer. However, at high cruising speeds, aerodynamic drag is much larger than lift-induced drag. Jets take advantage of low air density at high altitudes to significantly reduce air drag. Hence despite their lift-to-drag ratio disadvantage, they can travel more efficiently at high speeds than maglev trains that operate at sea level.

•**Routing**: While aircraft can theoretically take any route between points, commercial air routes are rigidly defined. Maglevs offer competitive journey times over distances of 800 kilometres (500 miles) or less. Additionally, maglevs can easily serve intermediate destinations.

•**Availability**: Maglevs are little affected by weather.

•**Safety**: Maglevs offer a significant safety margin since maglevs do not crash into other maglevs or leave their guideways.

•**Travel time**: Maglevs do not face the extended security protocols faced by air travelers nor is time consumed for taxiing, or for queuing for take-off and landing