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# Electrifying Takeoffs: Like Electrifying Trains

In this narrative, we explain the thinking behind the impact on society we expect from our technology. The story is based upon mostly forgotten history.

New York City's migration to electric trains[1] was started in 1902 and completed within six years after having relied upon steam trains for 80 years. Prompted by tunnel accidents, Albany mandated smoke-free trains to serve Manhattan by 1908. Eliminating the smoke, soot, embers, and boiler explosions made transportation much less dangerous, but also cleared the air, making living near transportation desirable. Productivity gains quickly produced high demand for Park Avenue Real Estate.

Part of the transformation included the construction of Grand Central Station and lowering trains under street level, but clearly these depended upon adopting electric trains and innovating through technical challenges of what became known as the third-rail power distribution. Energy costs were expected to be lower for the new electric train system and were. But, the main benefits were the higher level of capacity and service quality from increased throughput provided by bringing trains to the people without the negative impacts on passengers and nearby communities typical of steam trains.

[1] Wilgus. William J., American Society of Civil Engineers, Transactions. Paper No. 1079, THE ELECTRIFICAITON OF THE SUBURBAN ZONE OF THE NEW YORK CENRAL AND HUDSON RIVER RAILROAD IN THE VICINITY OF NEW YORK CITY. 1908

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Today, every day, airports accelerate the equivalent mass of a Blue Whale from standstill to 235 mph using a propulsion process that is 1/3 as energy conversion efficient as that of 1870's steam locomotive technology (see white paper Electrifying Takeoffs: Clear the Congestion and Let Them Fly). This inability to effectively convert energy to propulsion at much slower speeds than cruise is the main culprit behind today's slow departure rates and a major cause of airport congestion. It is impractical for an airplane engine to operate efficiently at 275 m/s and 0 m/s.

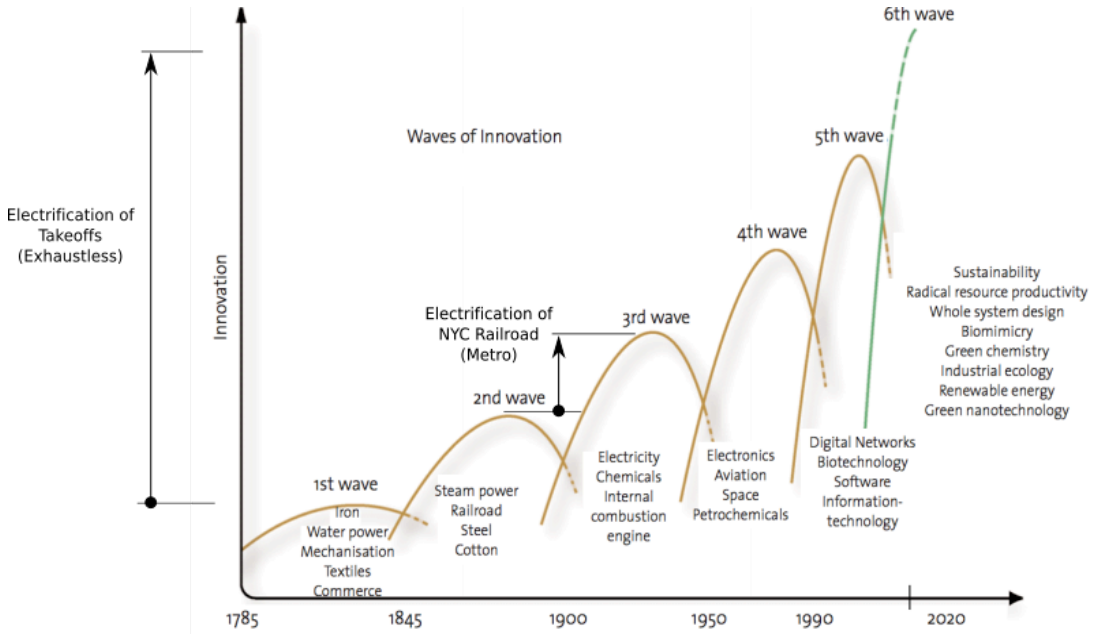


**Figure 1 Adapted from Hargroves and Smith (2005)**

Our technology allows cruise performance to improve without penalizing passengers, airlines, and communities near airports with more congestion, noise and pollution from poor takeoff performance tradeoffs. As can be seen in Figure 1 above, the impact looks promising. The poor takeoff performance represents a market failure that has plagued society in terms of congestion, pollution and noise that we correct by applying grid power and industrial technology to reduce the energy intensity of takeoff acceleration.

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