

# Personal Transportation in 2054

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## **1.0 Objective**

The objective of this report is to demonstrate the degree to which personal transportation vehicles of 2054 will be faster, more efficient, and more convenient than vehicles of 2004 as a result of research and development, cultural tendencies, environmental concerns, and economic fluctuations.

## **2.0 Scope**

Personal transportation can be defined as the act of transporting an individual by means of a vehicle usually operated by the individual. Generally, personal transportation vehicles have limited capacity as the intention of the vehicle is to transport the operator and sometimes one or more passengers. The automobile is an example of a personal transportation vehicle that usually enables passengers and the motorcycle and bicycle are vehicles which are less likely to enable passengers. Vehicles used almost exclusively for recreational and industrial purposes such as the All-Terrain Vehicle (ATV) and the forklift respectively, are excluded from this definition of personal transportation. This report will focus primarily on vehicles that fit the above definition.

## **3.0 History of Personal Transportation**

The beginnings of personal transportation can be traced back to ancient Mesopotamia at around 4000 BC when an important invention was quite literally taking shape. Humans were placing heavy objects on tree logs to move them and eventually these tree logs began to wear out in the center where the objects were placed. Formation of a rudimentary axle and wheels on both ends were the result.<sup>[6]</sup> Most experts credit the ancient Sumerian culture with the invention of the wheel around 3500 BC and installing it on carts and eventually chariots.<sup>[19]</sup> Although there is some debate whether or not the

horse was domesticated before or after the wheel was conceived, the earliest proof of horse domestication and use as a means of transportation is the infamous Sintashta chariot burials dating back to 2000 BC.<sup>[17]</sup> After the invention of the wheel and domestication of the horse there were many small improvements to personal transportation such as the fixed axle and the horse shoe but it would take over 3000 years for the next era to begin.

In 1769, French engineer and mechanic Nicolas Joseph Cugnot invented the first self-propelled road vehicle. Powered by steam, the vehicle traveled at only 2.5 mph and was mainly used by the French Military to haul artillery. Although not a personal transportation vehicle, Cugnot's invention inspired a revolution that would continue through most of the 19<sup>th</sup> century. It was not until Belgian-born engineer Jean Lenoir invented the internal combustion engine in 1858 that a new era in personal transportation was born. Relatively soon after Lenoir's invention, others followed with variations and built them into their own vehicles. Among these pioneers were people like Gottlieb Daimler and Karl Benz, whose automotive companies still exist today in 2004.<sup>[5]</sup> Unfortunately, vehicles were still too expensive for the average person. In the year 1900, only 1 in every 9,500 people in the United States (US) owned an automobile and most automobiles were still steam-powered or electric. However in 1908 Henry Ford, founder of the Ford Motor Company unveiled the "Model T" gasoline powered automobile that was affordable for the average American. Ford could sell his vehicle cheaply because he had invented the assembly line and implemented it in his manufacturing plant. By 1912, the Ford "Model T" accounted for three quarters of all the automobiles on the roads in the US and the age of the automobile had certainly begun.<sup>[16]</sup>

Almost a hundred years later in 2004, little has changed in terms of personal transportation. Although it has seen numerous small advancements, the automobile is essentially the same vehicle that Henry Ford popularized and delivered to the world in 1912.

## 4.0 Major Influencing Factors

There are many factors that have contributed to the evolution of personal transportation throughout history. Technology, culture, the environment, and the economy however, have had the greatest impact.

### 4.1 *Technology*

In the past, personal transportation has been changed by a multitude of factors but none have been as prevalent as technology. Technology can be seen as the catalyst for personal transportation advancement. As discussed earlier, the invention of the wheel sparked a new personal transportation era in which people could be transported more quickly and easily by cart. However, these new eras are most often few and far between. For example, it took almost four thousand years for the automobile to replace the domesticated horse as a primary means of personal transportation. Since the inception of the automobile is relatively recent, most experts believe that a new era in personal transportation will not occur for several centuries to come. Some researchers even speculate that science-fiction like de-materialization and re-materialization may mark the next era in transportation and forever transform our society. “Given the maglev’s potential, it could be the last in a series of transport technologies, unless we succeed in putting into practice some exotic devilry, such as the disintegrative beaming in Star Trek.”<sup>[3]</sup> Jesse H. Ausubel of Rockefeller University, NY and Cesare Marchetti of the International Institute for Applied Systems Analysis, Laxenburg, Austria are foremost researchers in the evolution of transportation (both personal and non-personal). Ausubel and Marchetti believe that the next new means of transportation will be “magnetically levitated systems, or maglevs, a ‘train’ with magnetic suspension and propulsion.”<sup>[3]</sup> Although interesting, maglevs are clearly outside the scope of this report.

While technology can spawn a new age in personal transportation, fortunately it also enhances vehicles during these lengthy eras. Technology improves personal transportation chiefly in terms of speed, efficiency, and convenience. For example, development of the engine has led to faster vehicles with better fuel economy. Innovations like power steering and the electric ignition have increased the convenience

of the automobile. In fact, the electric starter was first implemented in automobiles by Henry Leland of the Cadillac Motor Car Company in 1911 “after the wife of a friend had been killed crank-starting an automobile.”<sup>[16]</sup> In this instance, the adoption of technology seemingly enhanced the safety of the vehicle in addition to its convenience.

Although technology itself has great potential to reshape personal transportation, it only succeeds if it is accepted by society.

## 4.2 Culture

There is a cyclic relationship between culture and personal transportation in that, personal transportation is affected by culture and culture is also affected by personal transportation (Figure 1).

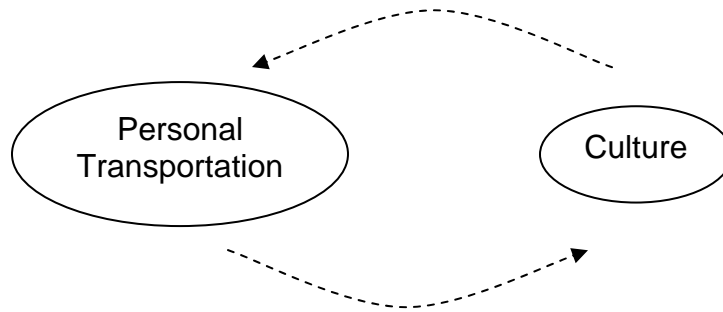


Figure 1: Cyclic Relationship between Personal Transportation and Culture

The impact of personal transportation on culture is most apparent at the beginnings of a new era. For instance in 1910 “the automobile was changing American life. It had already started to change the language: 'parking', 'necking', and 'petting' had made their way into the language.”<sup>[16]</sup> The adoption of the automobile has also led to many other social changes, such as the move away from walking and the increased size of cities. Marshall McLuhan writes that the automobile is an “amputation” for walking and that its use has been over-extended. McLuhan contends that the over-extension of

the automobile can be attributed in part to the obesity epidemic and air quality degradation.<sup>[13]</sup>

Although it may be true to say that an American is a creature of four wheels, and to point out that American youth attributes much more importance to arriving at driver's-license age than at voting age, it is also true that the car has become an article of dress without which we feel uncertain, unclad, and incomplete in the urban compound.<sup>[13]</sup>

Culture's influence on personal transportation today is demonstrated by automakers as they struggle to understand the cultural values in other countries and attempt to develop new vehicles that appeal to their foreign markets. Japanese automaker Toyota has resorted to driving its "engineers around the parking lot at a Dallas Cowboys football game in order to study the vehicular preferences of average Americans, the Japanese--who live in a country where things are small, especially the roads--were stunned at how large the pickups in the lot were, and how many of them they saw."<sup>[14]</sup>

### **4.3 *Environment***

"Americans now use about 1.5 gallons of gasoline per person daily for travel, the largest single use of energy."<sup>[4]</sup> In 2004, environmental concerns are having a profound effect on the evolution of personal transportation. Vehicle emissions are at dangerous levels in some cities and beginning to reach threatening levels in others. People with breathing conditions and lung diseases like asthma are particularly at risk in areas with emission problems. In the 1950s, there are few who would have predicted that there would be a high demand for bottled drinking water in fifty years, so it would stand to reason that in 2054 people may be breathing air from a canister in some regions. Fortunately there is immense pressure on vehicle manufacturers and government to fund

research into more efficient engines and explore alternative fuel sources that produce clean energy with no hazardous byproducts.

Government has also attempted to push cleaner air by implementing regulations. The state of California for instance is renowned for their strict emission regulations and on the 24<sup>th</sup> of September 2004 approved “the world's most stringent rules to reduce auto emissions that contribute to global warming.”<sup>[1]</sup> Vehicle manufacturers must adhere to these imposed guidelines in order to sell their product to Californians. In Canada, government has taken a more reactive than proactive approach. Seven Canadian municipal governments have instated fines for vehicle idling. That is, if an individual is caught idling their vehicle for longer than allowed bylaw (two minutes being the shortest as of 2004) they are subject to a small fine. The goal is to reduce the length of time Canadians idle their cars on a daily basis because “if every driver of a light-duty vehicle in Canada avoided idling for just five minutes a day, [Canadians] would save 1.6 million litres of fuel and prevent more than 1.4 million tonnes of the greenhouse gas, carbon dioxide, from entering the atmosphere.”<sup>[9]</sup>

#### **4.4 *Economy***

On September 9<sup>th</sup> 1929, the United States suffered its 4<sup>th</sup> largest stock market crash in history, marking the beginning of a decade long period of economic poverty and hardship known as the Great Depression. By the end of the next year, automobile production had dropped by over half from about 5.3 million units to 2.4 million.<sup>[16]</sup>

The Great Depression is an extreme example of the effects of the economy on personal transportation. More recent events such as the energy crisis of 1973 also demonstrate economic impact. In 1973, the oil rich middle-east began to deprive the Western world of oil thus increasing the price of oil from \$3 to \$5.11 per barrel overnight. As gasoline prices rose to record highs, Westerners started looking for fuel efficient vehicles. Japanese vehicles were already much more efficient than the American made vehicles so people started buying Japanese models to save money on



fuel. To compete with this new demand American automakers had to put the “American Muscle Car” aside and focus on developing more fuel efficient vehicles. <sup>[15]</sup>

In 2004, the economy is experiencing similar trend as in 1973 partly as a result of the ongoing US lead wars in the middle-east. Again in desperation people are looking for the most fuel efficient vehicles and as in 1973 the liberator is again the Japanese automakers. The Japanese automaker, Toyota was the first to successfully develop a new vehicle technology concept known as the gasoline-electric hybrid. The demand for the gasoline conserving technology is currently higher than the supply and it seems consumers are not concerned about the price. “Lexus decided to delay the release to accommodate burgeoning demand for the [hybrid] SUV...it has 9,500 confirmed orders for the RX 400h, 8,000 buyers on dealership waiting lists and about 46,000 potential purchasers...Pricing for the RX 400h hybrid has not been announced yet.” <sup>[2]</sup>

## **5.0 Personal Transportation in 2054**

It is quite clear that by the year 2054, personal transportation vehicles will be faster, more efficient, and more convenient than vehicles of 2004. However, the degree to which vehicles will be faster, more efficient, and more convenient is not as clear because it is moderated by the major factors influencing personal transportation described in the previous section of this report.

The state of personal transportation in 2054 can be effectively predicted by examining current research and development, considering the diffusion rate of vehicles in the past, and also taking into account the major influencing factors. As Ausubel and Marchetti tend to agree that the dominant vehicles fifty years in the future are already in development and perhaps even available today: “The highly successful machines are few—train, motor vehicle, and plane—and their diffusion slow. Each has taken from 50 to 100 years to saturate its niche.” <sup>[3]</sup>

## **5.1 Speed**

The need to go faster is a cultural trait that has been demonstrated by civilizations throughout history. The domestication of the horse for example enabled humans to travel great distances in much less time than by foot. Unfortunately humanity's need for faster vehicles is limited by technology. That is, people can only go as fast as their technology will enable them to go. When the automobile was adopted for instance, people were able to cover greater distances in considerably less time than with the horse.

Currently, the United States' National Aeronautics and Space Administration (NASA) is conducting a project to increase the speed of personal travel and also reduce the amount of traffic congestion caused by automobiles. By moving the majority of personal transit vehicles to the air where there is a lot more space, Small Aircraft Transportation System (SATS) will enable more direct routes and decrease terrestrial traffic jams. Although this may seem more like a dream than a project, the simple fact that the largest portion of the infrastructure is already in place indicates otherwise. That is, there are currently over 5,400 public use airports in the US (mostly underused) and ninety-eight percent of the US population lives within a thirty minute drive of one of these airports. Unfortunately, the vast majority of the public use airports are not equipped to handle an influx of personal aircraft in any weather condition. To overcome this obstacle NASA has been investing in aircraft technology research and development since 1995, producing safer, more affordable aircraft. The refinement of the following technologies to a degree which makes them affordable and safe will enable SATS to be realized: <sup>[12]</sup>

- Integration of Highway-In-The-Sky (HITS) with synthetic vision systems
- Simplified software-based flight controls
- Auto-land capability for the SATS class of aircraft
- Automatic Dependent Surveillance-Broadcast surveillance
- Airborne Internet communications

- Computational algorithms for automated traffic separation and collaborative sequencing <sup>[12]</sup>

However, technology alone will not dictate the success of the SATS project. It must be readily accepted by American culture. NASA envisions that their system will initially be used in “air-taxi-like systems with hired pilot operations” and believes that within fifty years SATS will develop cheaper vehicles (economic) that are safe and easy to operate (cultural), reaching the individual. <sup>[12]</sup>

## **5.2 Efficiency**

In 2004, increasing the efficiency of personal transportation is satisfying both economic and environmental needs. The emergence of the hybrid automobile is providing better fuel economy and lower emissions of greenhouse gases. Unfortunately, the hybrid automobile is but a minor improvement of the current automobile and a better, more technologically advanced solution must emerge in the next fifty years if the environmental situation is to drastically change.

Environmentally, the one-license one-car equation means that each car on average must be very clean. Incremental efficiency gains to internal combustion engines will not suffice. The alternative of three hundred million large batteries made with poisonous metals such as lead or cadmium also poses materials recycling and disposal problems. <sup>[4]</sup>

There are also some cultural issues to consider as well. The increased efficiency technology can not infringe upon cultural values like the need for a powerful, large, or appealing vehicle; otherwise it will not be accepted. For example, attempts to reintroduce the electric powered automobile to Western culture after its embracing of the

gas powered automobile were futile as it did not satisfy the need for a large, powerful automobile among other things.

The obvious solution to retire the gasoline powered automobile is the zero-emission fuel cell which generates electricity by means of a chemical reaction of compressed hydrogen gas and oxygen. This process is theoretically twenty to thirty percent more efficient than that of the current internal combustion engine (Figure 2).<sup>[4]</sup>

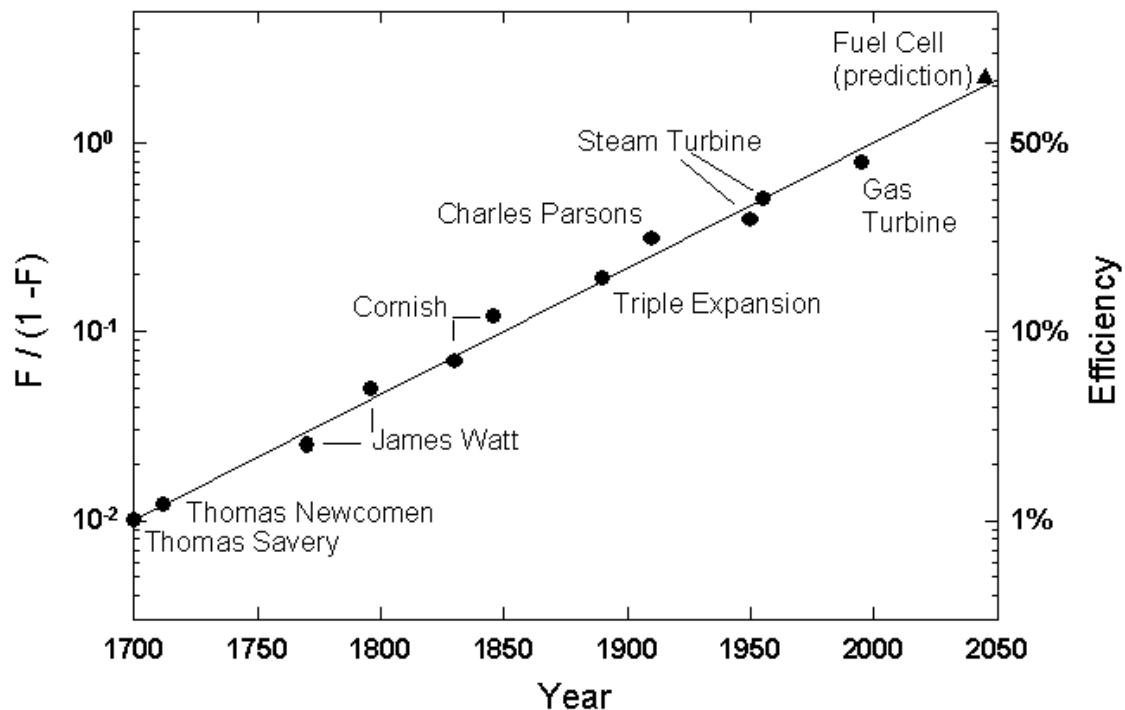


Figure 2: “Improvement in the efficiency of motors analyzed as a sigmoid (logistic) growth process, normalized to 100% of what appears achievable from the actual historic innovations, which are shown.”<sup>[4]</sup>

Unfortunately, there are many obstacles to overcome within the next fifty years to realize fuel cell powered vehicles. Hydrogen is a wonderful element in that it produces clean energy when combined with oxygen and that it is the most abundant element in the universe. Regrettably it does not come in a pure form and combines with almost any other element that it encounters. Therefore, hydrogen must be harvested from matter such as water or natural gas. “Currently, the cost of producing hydrogen fuel is greater

than the value of the energy it delivers.”<sup>[10]</sup> However, researchers are currently working to find an efficient means to produce hydrogen that would make the fuel cell feasible. An Australian team led by Professor Christopher Sorrel of the University of New South Wales is conducting research that will lead to “a commercial solar panel [by 2011] that would produce cheap hydrogen from water, a production method known as solar hydrogen.”<sup>[10]</sup> Other researchers are looking at different ways to yield pure hydrogen. A team from the United Kingdom is looking at ways to produce hydrogen from sunflower oil, air, water vapor and highly specialized catalysts, while Canadian researchers are looking at ways to produce hydrogen from gasoline using “reformers”.<sup>[10]</sup>

There are several other mitigating factors that will delay the emergence of the fuel cell vehicle, namely infrastructure and containment. Since a volume of hydrogen contains less energy than an equal volume of gasoline it must be compressed or stored in liquid form at extremely low temperature. Therefore, hydrogen is extremely difficult to handle.<sup>[7]</sup> Although the highways and roads are already in place to accommodate the hydrogen automobile, hydrogen fueling stations along these highways are not. These fuelling stations will only be built when the definitive technologies have been developed to efficiently produce hydrogen and effectively contain hydrogen. However, in a move classified as premature by most experts, the government of California declared a plan in April 2004 to have 150 to 200 hydrogen fuelling stations throughout the state by 2010.<sup>[8]</sup>

Building a hydrogen highway now is very premature, according to Joe Romm, executive director of the nonprofit Center for Energy and Climate Solutions. Romm, who worked for five years for the Department of Energy, said there would not be a viable market for hydrogen-powered cars for at least 20 to 30 years.<sup>[8]</sup>

As mentioned earlier, Professor Christopher Sorrel<sup>[10]</sup> believes that an efficient fuel cell technology will be ready as soon as 2011. However as Ausubel and Marchetti<sup>[4]</sup> point out, it will take another twenty or thirty years for fuel cell vehicles to become the primary choice of consumers.

Because of the large, lumpy investments in plant required, the traditional ten-year lifetime of cars, and gradual public acceptance, it will take two to three more decades before the fuel cell cars dominate the fleet. City air, now fouled mostly by cars, could be pristine by the year 2050. <sup>[4]</sup>

### **5.3 Convenience**

Humans have valued convenience since they realized they could use tools made of rock and wood (like the primitive axe) to save time and effort. The invention of the automobile was a convenient alternative to the horse in that you could travel continuously without stopping for a rest, food, or water as you must with a horse. As the automobile began to dominate personal transportation, complementary options were also invented to further increase its convenience. The car radio for instance, was invented in 1929 by a company which would eventually be known as Motorola. <sup>[16]</sup>

In 2004, there is a relatively new and very unique invention that has great potential to revolutionize personal transportation in the city. “The Segway HT (Segway Human Transporter, Segway) is a self-balancing motorized scooter with two wheels on a single axle, invented by Dean Kamen and unveiled in December 2001.” <sup>[18]</sup> As a result of its advanced design and technology, the operation of Segway HT is very natural. To move forward, a person must simply lean forward and to reverse, lean backward. The natural operation of the Segway HT makes it a convenient alternative to walking or cycling. Currently, the Segway HT is being used chiefly as an industrial vehicle by the US Postal Service for their parcel carriers and by Amazon.com to speed up warehouse operations. It has seen little success in the consumer market mainly due to its unaffordable price of \$5,000 USD per unit (November 2004). For most consumers, the cost outweighs the benefits; and with the increasing awareness of the health risks due to inactivity, people are less likely to trade their daily walking activity for a costly convenience.

Although the Segway HT's cost is currently unreasonable for most consumers, with time the price will decrease. When the first automobiles were emerging they were much too costly for the average working class, but eventually as the industry grew, companies became competitive and prices decreased.<sup>[16]</sup> Currently, there is no competition for the Segway HT so the price is set by Segway, LLC and its investors. When competing companies begin to appear within the next decade, the price of Segways will surely begin to decrease. Also, as new models of the Segway HT are released, more and more second hand models will become available for resale, making it more affordable.

Within the next fifty years, the Segway HT will undoubtedly become the dominant personal transportation vehicle in many cities in the world. As the renowned co-founder of Apple Computers, Steve Jobs has a unique perspective: "If enough people see this machine, you won't have to convince them to architect cities around it; it'll just happen."<sup>[11]</sup>

## **6.0 Conclusion**

By the year 2054, city air will be much cleaner as a hydrogen fuelled economy will have risen to dominate the personal transportation industry. Streets and highways will also be significantly quieter as the ambient noise from automobile engines will have become a sound of the past. Governments will have imposed strict laws prohibiting the use of gasoline vehicles, forcing citizens to move to the hydrogen automobile. Our dependence on fossil fuels will have almost vanished, lessening the Middle-Eastern grip on the Western world and perhaps changing the balance of power in the Middle-East.

Cities will have grown even larger with the increased mobility of humanity. Affordable, safe personal aircraft and an advanced Small Aircraft Transportation System will enable quick commuting over large distances.

A slightly more advanced version of the Segway HT and its competitors will dominate city transportation ever increasing the bustle of city life. Rather than waiting

for the bus or subway for a short commute, people will turn to their personal Segway HT for a quick, convenient ride.

In conclusion, the effects of technology, culture, the environment, and the economy on personal transportation and the degree to which these effects will increase the speed, efficiency and convenience of personal transportation has been revealed in the above report. Few people would disagree that it is not easy to envision the future and even few would disagree with highly revered physicist Neils Bohr who said, "Prediction is extremely difficult. Especially about the future."



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