



Autoway, A Practical Urban Transportation Mode for 21st Century

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Abstract: Autoway is a personal automated guideway transportation system for passengers and light freights. Some practical examples and a roadmap for Autoway deployment are given to illustrate Autoway as a comprehensive solution to traffic congestion, energy shortage, air pollution, and traffic safety. This will help government planners, urban architects, transportation engineers, real estate developers, and environmentalists to recognize a commercially viable urban transportation solution. This will also help corporate executives, investors and entrepreneurs to realize the business opportunities of Autoway as the transportation technology for the 21st century.

1. Challenges of urban transportation

We are facing serious urban transportation challenges around the world. Traffic congestion, energy shortage, air pollution, and traffic accidents are serious problems in large metropolitan areas all over the world.

To understand why the transportation tools of yesterday are no longer effective today, we need to identify what have changed in our society and environment. There are at least two significant changes in our urban regions. The first significant change is the big size of a city. The second significant change is the complicated economic structure of a modern metropolitan area and the corresponding traffic pattern.

A modern city can be very big, 100 kilometer across with millions of residents. Walking and bicycling are impractical for most commuters at such a long distance. Buses and subway trains that stop at every station will also be time-consuming for trips across the city. This makes automobile the desired choice of passenger transportation.

The complicated economic structure of a large city makes commuting trips dispersed, complicated, and distant. If we take a snapshot of trip origin and destination, very few people will share the same origin and destination. In a short time interval, say 5 seconds, perhaps every one will have a different origin and destination. In the 19th century, many employees of a company perhaps lived in the same neighborhood, and mass transit systems were well suited to the transportation needs at that time. This is why the once profitable mass transit systems have to rely on government subsidies for survival today, even in densely populated areas.

As a result, automobile is the most cost-effective, convenient and comfortable means for passenger transportation at present. The high demand for automobile also makes it the major source of traffic congestion, energy shortage, air pollution, and traffic accidents. Many cities have reached a point that building more roads will no longer improve the traffic performance.

Therefore, we have a traffic problem that cannot be addressed by existing modes of transportation. This has been proved by the traffic realities in major cities around the world. It is time to think outside the box and to develop a new mode of transportation.

Autoway is invented as a transportation technology for the 21st century. Autoway offers a comprehensive solution to traffic congestion, energy shortage, air pollution, and traffic safety. It is often difficult for people to see the economical and social impacts of a fundamentally new technology, as was the case for automobile and airplane at their beginnings. When the first car ran on the street of Detroit, it was reported as a useless monster, yet it became the dominant mode of urban transportation. When Wright brother's airplane made their first flight in 1903, it did not attract much attention from the media and the public, but airplane became the main mode of long distance transportation.

In this article, we will use some application examples to demonstrate Autoway as a commercially viable solution to the challenges of urban transportation in both developed and developing countries. This will help government officials, urban planners, urban architects, transportation engineers, real estate developers, and environmentalists to rethink the urban transportation and development strategy. This will also help corporate executives, investors and entrepreneurs to realize the business opportunities of Autoway as the transportation technology for the 21st century.

2. The concept of Autoway

Autoway is an automated personal transportation system for passengers and light freights, with a focus on commuting and e-commerce, as shown in Fig.1. Autoway uses small vehicles on an automated guideway system. The vehicle only stops at offline stations. As a result, the vehicle can maintain a high speed from origin to destination. In comparison, automobile has to stop at traffic light, and buses and subway have to stop at every station. The recommended vehicle size is 85 centimeter in width, 150 centimeter in height, and 200 centimeter in length. The vehicle is spacious for one person, or one adult plus two pre-school children seated in rear-facing positions, but still large enough to accommodate one wheelchair. The use of a vehicle for a single passenger is a natural choice of the prevalent commuting pattern of a modern society. This leads to the high energy efficiency, safe control of the vehicle, and the small size of the guideway.

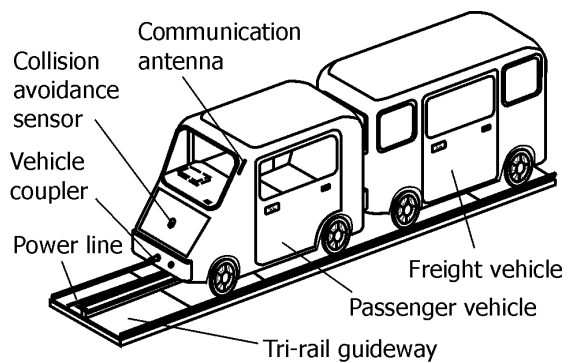


Fig. 1 Autoway

As the vehicle is automatically driven, the passenger is free to do what he wants. He can listen to music, read newspaper, browse the internet, watch a movie, make a phone call, drink a cup of coffee, or even have a nap. The only thing he needs to do is to input his destination. It is as easy to operate as the elevator, suitable to all people from school children to senior citizens.

As for e-commerce, Autoway provides a cost-effective system for local delivery of light freights of less than 220 lb (100 kg). As an automatic system, it is ideally suited to e-commerce for businesses and consumers. A distribution center can handle a region with a radius of 100 miles. In contrast to conventional freight delivery on the time scale of days or hours, Autoway can make delivery on the time scale of minutes.

The Autoway guideway is an open frame structure less than 3 feet in width. The tri-rail guideway essentially eliminates the possibility of derail. Autoway can be built as an overhead structure or an underground structure. The width of autoway is actually narrower than a typical crossbar of the electric power line. As a result, Autoway can be easily built on existing streets. It also provides a sturdy supporting structure for power and communication cables.

More detailed technical information about Autoway is available at the website <http://www.acroscape.com>. The main features of Autoway include:

- 1) Convenience, comfort, reliability, safety, and privacy;
- 2) Fuel efficiency: 500 mile/gallon (200 km/liter);
- 3) Lane capacity: 11,180 person/hour; and higher for emergency evacuation;
- 4) Speed: 65 mile/hour (100 km/hour) in urban areas, 90 mile/hour (150 km/hour) for intercity traffic;
- 5) Cost: \$5 million/mile including vehicles, guideway, and control system, or 5% of subway.
- 6) Residential population density: 500 to 100,000 people per square kilometer.

3. How Autoway addresses the urban transportation challenges

Traffic congestion, energy shortage, air pollution, and traffic accidents are serious problems in large metropolitan areas all over the world. Autoway provides a commercially viable solution to the challenges of urban transportation.

Traffic congestion: There are two types of traffic congestion: local congestion and corridor congestion. Local congestion usually occurs in business districts where the number of vehicles exceeds the local capacity. Corridor congestion occurs on main traffic arteries of large metropolitan areas. Although we often think traffic congestion as a phenomenon of the automobile, traffic congestion also exists in a different form on mass transits such as subway and buses. These congestions arise from the inherent shortcomings of these transportation modes. Initially traffic congestion can be reduced by building more roads. At a certain stage, the only solution left is to restrict the traffic volume either by charging extra fees, or by administrative measures such as special permit and quota of vehicle number, or a combination of them.

Autoway uses small vehicles to achieve the flexibility and convenience of a personal transportation system. This reflects the dispersed nature of origin and destination of a modern city. On the other hand, a significant number of vehicles actually share some segments during a trip. Autoway uses dynamic coupling to arrange these vehicles to form a train. This dynamic coupling technique makes the capacity of Autoway close to that of subway, or the equivalent of 5 highway lanes. Since Autoway is less than 3 feet wide, this can add a capacity of a 5-lane highway to existing streets. Autoway essentially can meet the needs of the most densely populated areas in the world.

Energy shortage: Energy shortage will become a global crisis if worldwide demand continues to increase on its current pace. Especially, the oil dependence of transportation is vulnerable to international conflicts, terrorist attacks, and natural disasters. For example, in the United States, cars and light trucks account for 43% of oil consumption, and ships, trucks, and airplane account for 25% of oil consumption. First, as Autoway uses electricity, alternative energy sources other than oil are available for transportation. Second, Autoway can have fuel efficiency 20 times higher than that of automobile, or an equivalent of 500 miles per gallon. Third, a transportation revolution will lead to more fundamental changes in urban living, and we can have better urban amenities at about 10% of the current energy consumption. Therefore, the widespread use of Autoway around the world will significantly alleviate the pressure of energy shortage and oil dependence.

Environment: Autoway will significantly reduce air pollution and noise pollution related to traffic. Since the fuel consumption of Autoway is only 5% of that of automobile, both the local air pollution and the green house effect to global warming will be significantly reduced. Furthermore, Autoway will spare the surface landscape from erosion related to road construction. As Autoway is typically built as an overhead structure, it will significantly reduce the interference of traffic with wildlife.

Safety: According to World Health Organization, every year 1.2 million people were killed and 50 million people injured in road accidents around the world. Traffic accident is the No. 1 cause of death for school children and young adults. The autoway vehicle is restrained on the track similar to monorail so that there is no danger of derail. The approach to safety on Autoway is collision prevention. Autoway uses the strict brick-wall stopping requirement. As the vehicle weight is 100 times less than a railway car, it takes only 2 seconds to stop an autoway vehicle in contrast to the stopping time of minutes for a railway train. This is different from many other personal rapid transit systems that use split second between vehicles to increase capacity. Autoway will be among the safest transportation systems. As Autoway is less vulnerable to bad weather, Autoway can be a safe alternative for air and highway travel during snow, fog and other bad weather conditions.

4. What makes Autoway a commercially viable urban transportation system

Automated transportation systems have been in use for a long time for certain niche applications. For example, the concept of Personal Rapid Transit (PRT) has been proposed and some prototype systems have been constructed. However, a cost-effective

system suitable for widespread applications has not yet been developed. Before we discuss what makes Autoway a commercially viable urban transportation system, it cannot be overemphasized that Autoway is not an automated highway system or an automated railway system. We should be cautious not to automatically apply the concepts and assumptions of existing transportation systems.

Autoway is a personal transportation system like walking, bicycle and automobile. Here “personal” is in the sense of private space, user-specific, or individualized service. Although personal transportation vehicles are usually small and privately owned, size and ownership are not the determining factor. An extreme example of personal transportation system would be Air Force One, a large airplane owned by the US government and used to meet the transportation needs of the president. A simple way to tell whether a system is a personal transportation system is how a passenger gets access to the vehicle, either by a ticket or by a key. A user of Autoway can specify his personal settings like music, temperature, wheelchair, etc., much like a personal computer. Therefore, Autoway can provide better and user-specific services at affordable costs, unparallel in existing modes of public transportation.

Autoway is a coordinated transportation system with a central control system. This sets it apart from other personal transportation modes like walking, bicycle and automobile. An analog would be the difference between civilian behavior (random) and military behavior (coordinated). As a result, vehicles travel in the same direction on Autoway can be pooled together (dynamic carpooling). This is the reason that a guideway less than 3 feet wide with small vehicles can give a capacity of a subway line or 5 lanes of highway. During emergency evacuation, the capacity can be doubled and even tripled.

Autoway uses the conservative brick-wall stopping requirement. The century-old brick-wall safety criterion in the railway industry requires the train to stop before hitting a hazard. Many in the PRT community favor a moving wall criterion of split second to increase the capacity. This is a reaction time criterion. As long as the front vehicle is safe, the vehicle behind it will also be safe if it applies the brake in time. In theory, modern sensors can take action in a split second. The choice of the conservative brick-wall criterion for Autoway is a consideration of error tolerance. Extremely high reliability is a must for both the initial acceptance and the widespread adoption of Autoway. Think about the insurance cost of a real transportation system where errors and accidents will certainly happen. The leeway to handle abnormal situations to minimize the damages is an important factor for safety and financial performance.

The choice of a vehicle size for one person is the starting point for many advantages of Autoway. This is one example that we cannot just copy the size of automobile. The average occupancy of automobile in US is 1.1 passengers. Just by changing the size of the vehicle from 4 passengers to 1 passenger, without anything technically fancy, we can reduce the energy consumption to about one eighth of a typical automobile. This choice is also a safety consideration. This may be contra-intuitive since people would associate safety with a heavy car. For collision avoidance in a guideway system, physics tells us that it is easy to stop a light vehicle. The bumper can also handle a collision better if the

vehicle is lighter. The small vehicle size will also significantly bring down the cost of vehicle, guideway, and parking.

The choice of small vehicle size leads to a narrow guideway less than 3 feet in width. As a result, Autoway guideway can be built on existing streets as an overhead structure (or underground structure at a slightly higher cost). People have an instinct against overhead structure since what come to mind are the bulky and noisy overhead highway and railway. Autoway is quite different, as shown in Fig. 2 for a comparison between Autoway, highway, railway and monorail. The guideway is a narrow open-frame structure. Such open-frame structures are very common both indoors and outdoors, for example, as seen in ABC news broadcasting studio. The noise level will be very low due to the vehicle weight 100 times less than a railway car. The Autoway guideway, with proper architect design, can contribute significantly to the beauty of urban landscape like a silk gift ribbon.

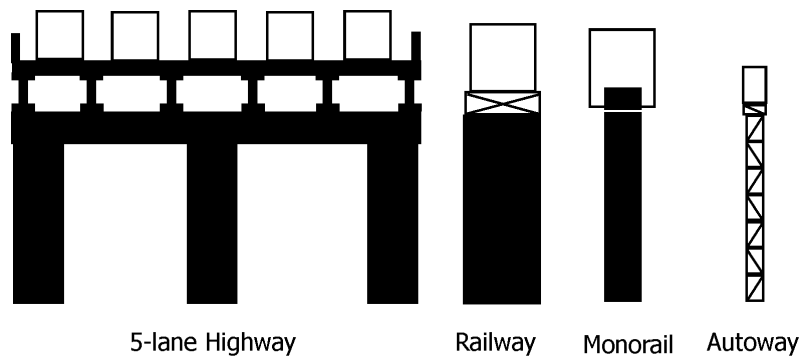


Fig.2 Comparison of guideway and vehicle profiles

The concept of station is also quite different from that of mass transit systems. A station on Autoway is the place that a passenger makes a request for service and gets on a vehicle. A passenger does not need to worry about which platform to go, which train to take, and which direction to go. On Autoway, all the passenger needs to do is to get on a vehicle and input the destination. The system will take the passenger directly from origin to destination without stop or transfer.

The simplest station would be just a notification device for a couple hundred dollars. A sophisticated station may be a million-dollar structure with parking lots, maintenance service, user registration, food and beverage, stores, and restrooms. At a station of mass transit, a large number of people will be accumulated before boarding. At an Autoway station, people come and go continuously. As a result, the Autoway station will be very small with a typical space for only a few vehicles. Autoway stations are built for the dispersed personal transportation. There will be many stations but only a small number of people at each station. Autoway stations can be built directly inside office buildings, apartment buildings, shopping centers, hotels, restaurants, hospitals, schools, and airports. The Autoway station can be located on the third floor for an overhead guideway or the basement for an underground guideway. When Autoway becomes a well-developed network in the future, every home will be an Autoway station. As a result, a considerable number of stations are private stations with controlled access.

Carriers are something new on Autoway. They are used in Autoway parking facilities to park and retrieve Autoway vehicles, much like an automatic book retrieval system in a library or an automatic warehouse system. A carrier may have the ability to move vertically in a multi-story parking facility. The choice behind a separate carrier reflects the design philosophy of Autoway for a light vehicle: Do not carry any unnecessary weight around.

The commercial success of a new transportation system is the result of significant, often order of magnitude, improvements over existing systems on certain aspects. Autoway offers a convenient, fast, and comfortable transportation to all the people from school children to senior citizens. The vehicle cost, fuel consumption, and the cost per passenger-mile will be one order of magnitude lower than automobile. Autoway will be order of magnitude safer than automobile. The construction cost of Autoway will be one order of magnitude lower than the cost of subway system. Next we will look at some examples of commercial applications.

5. Commercial application examples of Autoway

Autoway is a network transportation mode. Like other network systems such as the electricity grid, the telephone network and internet, the benefits are realized with an extensive network. Only when a large number of users were connected to the electricity grid then became true Edison's predication that electricity will be available at such a low cost only the rich will use candles. Similarly, the automobile and highway became more useful when an extensive road network was constructed.

To build an extensive network is a substantial infrastructure investment even though Autoway can significantly reduce the transportation cost. It is a hard sale for a new technology. Then there is the question of last-mile and first-mile of connecting to individual users. This obstacle has puzzled people in the PRT community. Some suggested that small feeding network for subway may be a starting point, but this approach is not commercially viable.

It is true that the full benefits of Autoway can only be delivered with an extensive network connecting many homes and businesses. Then people from school children to senior citizen can enjoy the freedom of transportation unparallel in existing transportation modes. Local delivery can be performed at such a high speed and low cost that it will change the urban lifestyle. Gourmet food can be delivered to every home, and we may say, in analog to Edison's remark about electricity, only the rich will prepare their meals at home.

However, Autoway can be first implemented for certain applications without an extensive network. We will look at some commercially viable examples for initial deployment. The legends of Autoway, shown in Fig. 3, will be used to illustrate the applications without the complexity of the engineering









Station	
Loading station	
Unloading station	
Parking	
Stop	
Control center	
Switch	
Carrier	

Fig. 3 Autoway Legend

details. For example, at a switch point the guideway will have a small ramp, and such details are omitted for clarification.

(1) **Corporate campuses and recreational facilities.** Autoway will be a more convenient and efficient choice for the transportation of people and small goods in a large corporate campus than other options like car, shuttle bus, and delivery truck. Autoway will go directly inside buildings, parking lots, and warehouses. People can get to other buildings at any time without worrying about parking. Goods can be delivered almost

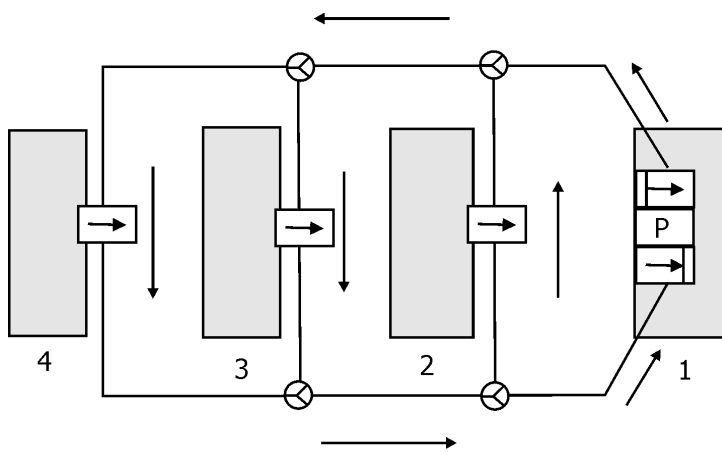


Fig. 4 Schematic Autoway layout for four buildings

immediately on demand at a low cost. A visitor can park her car at a visitor parking lot and uses Autoway to get to the desired destination. Autoway is justified for the improved efficiency and the lower operational cost. This can be started small for a few buildings, as shown in Fig. 4. Only in building 1 some space for Autoway parking is needed, and this approach is more cost-effective than bridges or tunnels.

(2) **Congested urban areas.** Autoway is ideally used as a network mode, but the initial implementation can be on a congested traffic corridor to give immediate congestion relief. Then we get to the first-mile/last-mile question: how to get people from their homes to Autoway stations and how to get people to their offices at a business district.

The Autoway solution is to provide the last-mile service and let people take care of the first-mile on their own. A commuter makes three types of contribution to traffic: residential local traffic, corridor traffic, and business local traffic. The Autoway solution gets rid of the corridor congestion and business local congestion. Frequent bus service can further extend the coverage of Autoway service. At this stage, Autoway actually can significantly increase ridership on existing mass transit systems. For cities with a moderate population density such as Houston, Los Angeles, Northern Virginia, and most middle-sized cities in US, this essentially solves the traffic congestion problem. For comparison, toll road and dual-mode only address the corridor traffic congestion.

Let us see how such a system can be profitable. Suppose we have a 20-mile Autoway system going from the residential area to the downtown business district. In a typical city in the United States, for automobile, the toll will be \$2, the vehicle/gas/insurance will be \$0.3 per mile, and parking will be \$10. The total cost for a round trip will be $\$2 \times 2 + \$0.3 \times 20 \times 2 + \$10 = \$26$. Since vehicle and insurance are fixed cost, many people will only count the gas cost, and that still gives us \$18. On Autoway, the cost will be $\$0.05 \times 20 \times 2 = \2 . In estimating the cost of Autoway at \$0.05 per mile, we assume the usage is on par with a highway lane, which is much lower than the capacity of Autoway.

In another way, assuming a daily ridership of 6000 for 250 work days in a year, at a competitive price of \$18, the operational profit will be \$24 million a year. As the ridership increases when a network is formed, the price will be reduced accordingly. If Autoway is built by the government like public streets and roads, the price will be just the cost for infrastructure and operation, or about \$0.05 per mile.

Admittedly, such calculations are too simplistic, but it helps to show the big picture. Here we only compare Autoway with automobile. In congested areas, Autoway is faster, more convenient, and more reliable. If we take public transits into account, the general picture will not change. In the United States, the capital investment for public transit is generally paid by the government. Fare collection generally pays for less than 50% of the operational cost. The price for a round trip is \$2 to \$5. Even such a low price can only attract a limited ridership, typically less than 5% of all commuting trips.

In developing countries such as China, the scenario will be different. Although public transportation is well developed, the higher population density and more serious congestion make both bus and subway literally packed during rush hours. The low price of taxi, typically around \$0.25 per mile, is a limiting factor for the price on Autoway. In comparison with a typical street traffic speed of 10 miles per hour, Autoway is much faster and comfortable. It can be marketed as the transportation system for the emerging middle class. Suppose we put the price at \$0.15 per mile, and a daily ridership of 20,000 for 300 days in a year, the operational profit will be \$24 million.

A schematic urban Autoway layout is shown in Fig. 5. The stations in the residential area are about one to two miles apart. The stations can be converted from existing park-and-ride facilities in many US cities. As the ridership increases, the stations can further include shopping, package delivery and other business functions. When an Autoway network is formed in the future, these stations will change their

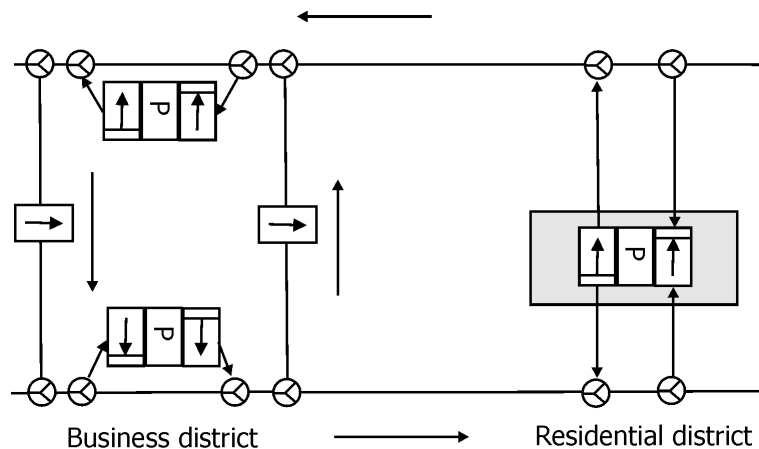


Fig. 5 Schematic urban Autoway layout

role to connections to rental cars and chartered buses. The stations in the business area will be located in existing buildings with potential Autoway users, such as offices, conference centers, and hotels.

(3) **Regional transportation system.** The distance from 200 km to 500 km is too long for driving but too short for efficient air travel. This is often the case for intercity travel in an economic region. For example, the Boston-New York-Washington DC region, the Southern California region, the Guangzhou-Hong Kong region, and the Yangtze Delta

region around Shanghai are all vital economic regions with heavy intercity traffics. A popular recommendation is high-speed railway. Advocates of high-speed railway overlook the fact that a modern city is no longer a point but a vast area. People travel from some point in one city to some point in another city, and only a tiny fraction is from city center to city center. Autoway will be very effective to provide such direct point-to-point service. This can be considered a natural extension of urban Autoway system. In some situations such as the densely populated regions in China, the regional Autoway system can also be constructed simultaneously.

We will use New York-Washington DC as an example. The distance between the two cities is 360 km (225 mile). Table 1 lists the transportation options in this corridor. Half hour is added to travel time of mass transit systems for check-in and boarding. All are commercial operations except for the Acela train service since the capital investment for Acela train is paid by the government. The low price of Express bus only exists as a niche market between the Chinatowns of the two cities. The cost on Autoway will be \$11.25 but the suggested price of \$54 will be a very competitive choice. The advantages for passengers include the convenience of travel at any time and the real travel time comparable to flight. Since there are hundreds (eventually millions) of Autoway stations in the region, Autoway can serve a large number of passengers.

Table 1 Transportation options in New York-Washington DC corridor (360 km)

Transportation mode	Maxim speed (km/hr)	Time (hr)	Total time (hr)	Price (\$)	Unit price (\$/km)
Express Bus	120	4	4.5	17.5	0.05
Airplane	1000	1.5	2	80	0.22
Train (Acela)	240	3.1	3.6	80	0.22
Automobile	120	4	4	61.2	0.17
Autoway	150	2.4	2.4	54	0.15

(4) **Feeder to airport.** Although air travel is fast, the trip to an airport can be time consuming. The urban Autoway system can be extended to the airport to bring passengers directly to the check-in areas of different airlines. In addition, Autoway can be the internal transportation system for airport, providing fast and reliable transfer of passengers and luggage.

(5) **Natural parks.** Construction of roads at natural parks in mountainous areas and lake areas may be costly and prone to soil erosion and damage to the natural environment. Autoway, due to its narrow overhead guideway, can be constructed to protect the environment and to provide people easy access.

6. Roadmap for Autoway deployment

Table 2 lists a roadmap for Autoway deployment. We will see in 20 years Autoway will emerge as the major form for urban transportation. Autoway is an essential addition to existing transportation modes to effectively address the transportation challenges in the 21st century. Autoway does not replace existing transportation modes, instead it changes

the way we use existing modes of transportation and improve the performance of the whole transportation system. For example, passenger rail will be limited to tour services similar to the cruise ships, but freight rail will continue to be profitable.

Table 2 Roadmap for Autoway deployment

Time period	Milestones
2006-2007 (2 years)	Fully functional Autoway prototypes tested. Autoway became known to the general public. Research and education in related fields launched.
2008-2010 (3 years)	Initial deployment in cities, corporate campuses, airport feeders. Autoway standard established. Best practices for Autoway construction and urban architecture established. Special vehicles for disabled people developed. Autoway emerged as a major technology-based manufacturing industry.
2011-2015 (5 years)	Urban deployment in congested areas in large scale, and urban congestion and air pollution will be solved. Regional network deployment in large scale. New Autoway-oriented housing and community developed.
2016-2025 (10 years)	Autoway becomes the major form of urban transportation, supplemented by road and trail network. National network of Autoway formed. An alternative for long distance travel and emergency evacuation. New cities and much of existing cities are Autoway-oriented, and changes of business and urban lifestyle are expected. Oil dependence ended. Urban household energy consumption reduced to about 10% of current US level. Traffic related deaths reduced by 95% from 2005 level, or more than 1 million people saved every year worldwide. US urban land occupied by roads and parking lots will be reduced and converted to open green space.

Autoway will contribute greatly to our social and economic development. Think about the railway industry in the 19th century and how it transformed the economy. Think about the automobile industry and airline industry in the 20th century and how they changed our personal and business world. Autoway will further extend the physical boundaries of daily human activities and enrich our personal, professional, and cultural experiences. If we take two hours as the time limit for most human activities, Autoway will extend the physical boundary to a region with a diameter of 200 miles.

As a transportation technology for the 21st century, Autoway will bring a lasting economic boom to countries with mass production and construction of Autoway. The

roadmap will help corporate executives, investors and entrepreneurs to realize the business opportunities of Autoway. Many traditional manufacturing industries in developed countries have suffered a long time of downturn with significant loss of jobs. This technology-based manufacturing industry will provide millions of job opportunities in vehicles, guideway, communication and control equipment, steel-making, power generation and distribution, and construction.

The roadmap will help government officials, urban planners, urban architects, transportation engineers, real estate developers, and environmentalists to rethink our urban transportation strategy and how we build our cities and urban communities.

A choice of transportation technology will have far-reaching impacts on the economical and social development of an urban region. We have seen the rise and fall of cities with the change of transportation technology from horse carriage, canal, railway, highway, to airline transportation. An early strategic thinking about Autoway will be rewarded with financial savings, better transportation infrastructure, and sustained economic growth.

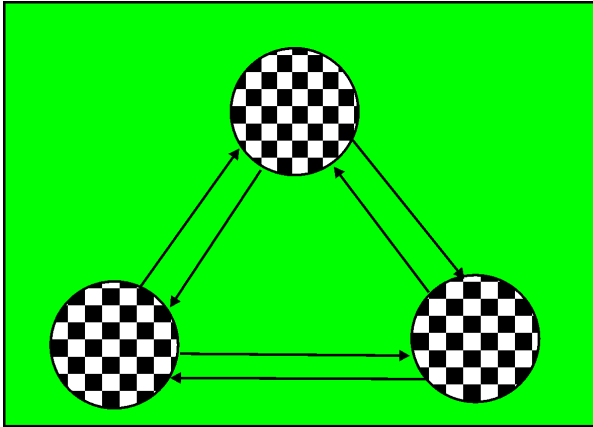


Fig. 6 Urban islands in a sea of open green space

The appropriate street pattern and urban structure depend on the choice of transportation modes. This will be a rich field of exploration for urban architects. As an example for stimulating more ideas, an Autoway community can be built with islands of high population density villages surrounded by a sea of open green space, as shown in Fig. 6. Immersed in the green space are traditional single-family homes connected to Autoway, as shown in Fig. 7.

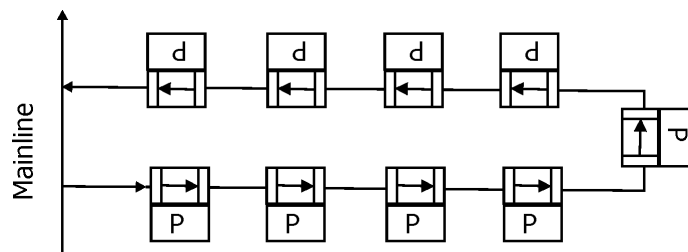


Fig. 7 Schematic Autoway layout for single family homes

Immersed in the green space are traditional single-family homes connected to Autoway, as shown in Fig. 7. The residents will have a wide range of housing options from single-family homes to Autoway-oriented carefree urban villages, all in one community. This garden city can have a population density of 10,000 per square kilometer and a green open space greater than 50%. The three networks of Autoway, road, and trail will serve the various transportation needs of commuting, shopping, walking, and bicycling. Children can go to school and other activities safely on their own. Commuting is a comfortable ride without congestion. Shopping is done online and the goods are delivered in less time than a trip to a nearby store at present. Meals are sent to the home almost instantly upon request.

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