

## CHAPTER X

# Capital Needs

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Before transit services can be provided, a number of capital items are required. The capital items required for public transit service include vehicles, passenger amenities, administrative and maintenance facilities, administrative computer programs, bicycle/pedestrian facilities, and advanced public transportation system technologies.

### VEHICLES

The PanTran vehicle fleet ranges from a 1996 bus to a 2002 bus. The buses have an average vehicle-life of approximately five to seven years, or 150,000 to 200,000 miles (according to the Federal Transit Administration guidelines). Several of the vehicles will require replacement in the upcoming years. Depending on the service alternatives chosen, additional vehicles may also be required. The following text presents information regarding the alternative fuel vehicles which are used across the United States. The alternative fuel vehicle information could apply to the Eastern Panhandle Region due to the non-attainment status in the region.



### Alternative Fuels

To reduce pollution from mobile sources, the national Clean Air Act Amendments of 1990 encouraged the use of clean fuels such as methanol, ethanol, bio-diesel, and natural gas derivatives (including compressed natural gas, liquefied natural gas, and liquefied petroleum gas). In order to develop a working concept of the different alternative fuels, their advantages and disadvantages, and their potential application for PanTran, the following review of the relatively common alternative fuels has been prepared.

## Methanol

Most of the methanol used commercially within the United States is manufactured from natural gas, making it economical to utilize. The tailpipe emissions of methanol are generally considered to be about half as reactive as an equal mass of emissions from gasoline or diesel fuel, promoting its use to reduce ozone in urban areas. By volume, methanol has slightly more than half the energy content of diesel fuel and gasoline. Due to the above characteristics, a methanol engine will consume slightly over twice the volume of fuel per mile of service, as compared to a diesel or gasoline engine.

In the past few years, the transit authorities in Los Angeles, California and Seattle, Washington have retired their methanol programs due to the fuel's highly corrosive properties. After spending \$102 million on methanol buses since the year 1989, the Los Angeles County, California transit officials declared their methanol anti-pollution program a failure because the buses are prone to costly mechanical repairs. Officials of the Seattle, Washington transit agency eliminated their methanol demonstration program after a trial period of five years. Test results of the program indicated that severe engine malfunctions were experienced on the buses at 60,000 and 70,000 miles, largely attributed to the corrosive nature of the fuel.



## Ethanol

While not being as corrosive as methanol, the major use of ethanol is currently limited as an octane additive and oxygenate for gasoline. Ethanol has many benefits in that it produces lower carbon monoxide emission rates than gasoline, has a higher energy density than methanol, and has a lower toxicity than either methanol or gasoline. According to the February 1992 *Information Update* by Detroit Diesel Corporation, ethanol costs almost twice as much as methanol, making its use limited as a motor vehicle fuel due to the economic drawback.

## Compressed Natural Gas

The strength of compressed natural gas (CNG) as an alternative fuel for transit buses is that it is generally less expensive per unit of energy than gasoline or diesel fuels. CNG fuel also has the potential to reduce the nitrogen oxide emissions,

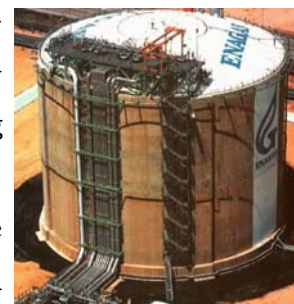
reactive organic hydrocarbons, particulate matter concentrations, and carbon monoxide concentrations by as much as 90 percent (per the Transportation Research Board, Transit Cooperative Research Program, 1993). The advantages of a CNG bus include no visible pollution and a quieter operation. Over the last several years, CNG has become the alternative fuel of choice in the United States transit systems.

Historically, the weakness of CNG fuel is its difficult storage requirements. CNG is typically stored in high pressure cylinders under maximum pressures. The high weight, volume, and cost of the storage tanks have been a barrier to its commercialization as an alternative fuel. The recent development of lighter aluminum tanks, however, has reduced this disadvantage to some degree. Another problem with CNG is associated with the moisture in the compressed fuel freezing during the fueling process, since the approximate time to fill a bus may be three hours. Other problems that have been encountered include the quality of local CNG supplies, limited testing of altitude effects on CNG, and limited CNG testing in extreme temperatures.

CNG vehicles typically cost \$30,000 to \$35,000 more than diesel powered equivalent buses. In addition, a CNG refueling facility with an adequate capacity to fuel a substantial portion of PanTran current fleet (for example) would cost between \$600,000 and \$1.2 million. Additional costs would be incurred to upgrade the maintenance facilities with the required safety features and to provide emergency response equipment and training.

### Liquefied Natural Gas

Liquefied natural gas (LNG) has only recently received attention as an alternative fuel. The potential advantages of LNG lie in its economic considerations, since the fuel processing costs are much less than that of the other gaseous fuels. LNG also has a greater potential to reduce the nitrogen oxide and hydrocarbon emissions when compared to diesel and gasoline fuels. Currently, the biggest obstacles facing LNG are the lack of availability and its storage and handling facility requirements.



LNG Storage Tank

### Liquefied Petroleum Gas

The advantages and disadvantages of liquefied petroleum gas (LPG) are similar to those of natural gas. One advantage of LPG is that gasoline engines can be easily converted due to its high heating and high octane characteristics. LPG is also well established in its transit fleet applications. According to the June 1989 *Alternative Transportation Fuel in the United States* by R.F. Webb Corporation, approximately 350,000 LPG transit vehicles were in operation in the United States. In 1995, the Department of Transportation estimated over 750,000 LPG transit vehicles would be in operation by the year 2000. The main disadvantage of LPG is the lower engine performance of transit vehicles. The conversion of an engine from gasoline to LPG will usually cause a 10 to 15 percent power loss.

### Diesel Fuel

Diesel-fueled engines have traditionally dominated the transit vehicle marketplace due to diesel's efficiency and durability. From an air quality perspective, diesel engines have very low tailpipe emissions of carbon monoxide and other organic gases. The concern from an air quality perspective, however, has been the diesel emission rates of the nitrogen oxide emissions (Nox) and particulate matter. Due to increasing environmental pressure to reduce the above emissions, the Environmental Protection Agency and American Public Transit Association have developed stringent Nox and particulate matter regulations. The Clean Air Act Amendments (CAAA) permit the use of clean diesel in urban buses provided that the clean diesel engines meet the CAAA's particulate matter standards.

In partial response to the 1990 CAAA recommendations for cleaner burning fuels and the continued development of the previously mentioned alternative fuels, the traditional diesel fuel engine has made great strides toward developing cleaner burning particulate traps and improved catalytic converter technology. Diesel engine manufacturers have been successful in lowering the Nox and particulate tailpipe emissions while still maintaining diesel's efficiency.

Barring conversion to alternative fuels, a number of steps can be taken to substantially reduce the air quality impacts of diesel-fueled transit buses. Various

transit systems have been successful in reducing the particulate emissions through the application of “clean diesel” technology. The utilization of a low sulphur fuel has proven to reduce the average annual particulate emissions of a transit coach from 935 pounds to 260-300 pounds, roughly a 70 percent reduction. In addition, installation of an electronically-controlled fuel injection system and specially designed transmission has dropped emission levels by 120 pounds of particulate matter annually, for a total emissions reduction of 87 percent.

“Clean diesel” technology could be appropriate for PanTran if funding assistance for alternative fuel vehicles is unavailable. Without such funding assistance, PanTran could still have a greater impact on local air quality through the purchase of new diesel equipment with “clean diesel” standards. In pursuing this route, PanTran would eliminate the worst polluting vehicles from the existing fleet.

### Bio-Diesel

Bio-diesel is a clean burning alternative fuel made from the domestic renewable resources of vegetable oil and animal fat. Bio-fuel consists of the mono-alkyl esters that are derived from vegetable oils or animal fats which conform to the ASTM-D-6751 specifications for use in diesel engines. This fuel is then mixed with diesel to reduce the amount of pollution that the vehicle normally produces. At this time, there are 14 companies producing a capacity of 200 million gallons of bio-diesel.

The pollution reduction depends on the amount of bio-fuel that is mixed in with the diesel. The amount of carbon monoxide (CO) is reduced by 12 percent when the mixture is 20 percent bio-fuel and 80 percent diesel. The maximum amount of CO reduction is 48 percent with 100 percent bio-fuel. The disadvantage of bio-diesel is that it increases the production of Nox by 2 to 10 percent, depending on the mix of bio-fuel to diesel.

One advantage of bio-diesel is that the fuel can be used in the existing PanTran bus fleet with a small amount of engine adjustment at a low cost. There are several grant sources through the Federal Transportation Administration (FTA) and

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Department of Agriculture to aid in funding bio-diesel conversions, such as the Clean Fuel Program and Congestion Mitigation Air Quality Program.

### **Bicycle Racks on Buses**

The concept of bicycle racks on public buses has gained widespread acceptance and popularity over recent years, particularly in smaller transit systems. Bicycle racks are used as an inducement to increase transit ridership as well as to encourage non-motorized forms of transportation. A reasonable cost for a two-position front-mounted bicycle



rack is approximately \$800 to \$1,200 per vehicle. This cost could be reduced if a local bicycling store could be recruited to provide the rack at a reduced cost.

The Los Angeles County, California Metropolitan Transportation Authority and the Colorado Springs, Colorado Transit agency, for example, use stainless steel racks that hold two bicycles each. The Central Contra Costa Transit Authority of Concord, California and the Colorado Springs, Colorado transit agency are currently providing front-mounted bicycle racks on their entire fleet. MET Transit in Billings, Montana has installed bicycle racks with a very positive response from the community.

The most common type of bicycle rack is placed on the front of the vehicle so that the driver can watch the loading and unloading, and has space for two or four bicycles. The bicycle racks are available on a “first-come/first-served” basis and are provided with a notice indicating that the passenger is liable for all damages. Passengers must be able to load and unload their bicycles on their own. Bicycles fitted with child seats are typically prohibited from utilizing the racks as the seat could block the bus’s turn signals.

The initiation of bicycle racks on transit buses could be a good opportunity for a promotional campaign for the environmentally-friendly citizens of the Eastern Panhandle Region. A benefit of adding bicycle racks to the entire PanTran fleet is the ability to expand the transit system’s service range without increasing the

service operational costs. The only drawback of bicycle racks is the additional time necessary for loading and unloading the bicycles. However, operational problems associated with use of the bicycle racks can be minimized through the development and distribution of a pamphlet regarding the correct use of the rack.

## PASSENGER AMENITIES



The “street furniture” (shelters, benches, lighting, etc.) provided by the transit system is a key determinant of the system’s attractiveness to both passengers and community residents. In addition, the “street furniture” increases the physical presence of the transit system within the community. Bus benches and shelters can play a large role in improving the overall image of a transit system, and in improving the convenience of transit as a travel mode. More importantly, shelters are vital to those waiting for buses in harsh weather conditions. Adequate shelters and benches are particularly important in attracting ridership among the non-transit-dependent population—those who have automobiles available as an alternative to the bus for their trips.

The location preference for “street furniture” should be given to areas with a high proportion of elderly or disabled passengers and areas with a high number of daily boardings.

Lighting and safety issues are equally important along major highways. This could range from overhead street lighting to a low-power light to illuminating the passenger waiting area.

The average cost of a modern glass and steel shelter is \$8,000 to \$15,000 for most areas. The maintenance and the vandalism repair of bus benches and shelters is a very minor cost. Modern benches and shelters are very durable and resistant to vandalism. Many transit agencies have even had benches provided by advertising firms at no cost to the transit agency.

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PanTran currently does not have any passenger shelters. There are several waiting areas though, such as those at Wal-Mart, the Martinsburg Mall, and the grocery stores. Additional shelters and benches may be needed in order to improve the transit service within the Eastern Panhandle Region.

### **ADMINISTRATIVE CAPITAL NEEDS**

The existing administrative office has worked well for PanTran. Since the PanTran administration and maintenance facility is only a few years old, a new facility should not be needed for 15 to 20 years.

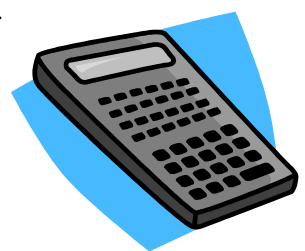
Other administrative capital needs include updating the computer hardware and software as needed. Scheduling and dispatching software for the transit service is another future technological move for PanTran. The software has a price range from \$10,000 to over \$100,000, depending on the type of system. Each company prices the software differently—by trips per day, number of workstations, or number of vehicles. The cost for PanTran should be approximately 20 percent of the total software cost, with the remaining 80 percent funded by the federal government.

### **BICYCLE/PEDESTRIAN FACILITIES**

At one end or both ends of their transit trips, virtually all transit passengers also travel on foot or on bicycle. A key element of a successful transit system, therefore, is a convenient system of sidewalks and bikeways accessing the transit stops. PanTran should work with the local jurisdictions to review the construction plans and scheduling priorities for pedestrian sidewalks and bikeways, so that these plans coordinate with the transit passengers' needs.

### **ADVANCED PUBLIC TRANSPORTATION SYSTEMS**

A key consideration in long-term planning is the impact of technological improvements that can benefit transit services. PanTran should continue to examine future technologies beyond this study's timeframe. In recent years, technological research and development programs have been incorporated



into the Intelligent Transportation System (ITS) concept. The application elements of ITS for public transportation are known as Advanced Public Transportation Systems (APTS).

APTS applies many high tech developments to the transportation realm. Most of the APTS developments have come from the military and financial arenas. One such military development is the use of Global Positioning Satellites (GPS) to determine the exact location of an object through triangulation, radio frequencies, and computers. GPS can also be employed to improve transportation systems through bus tracking. Likewise, the same principles used in the financial arena for credit/debit cards and building security systems can be applied to the transportation field. These technologies can be utilized to monitor passenger boarding and alighting locations, debit the fares from bank accounts, or charge the fares to the appropriate human service agency.

Advanced traveler information systems, for example, are intended to forewarn the public of delays on the transportation network. These may take the form of sign boards on the highway which advise travelers of congestion ahead, or traffic reports accessed on television or over the phone.

Automated vehicle location (AVL) systems employ one of several means of determining the location of a vehicle. By monitoring the historical locations and demands of the vehicles, transit planners can better refine schedules and networks in order to optimize the vehicle workloads. Logical links to the AVL systems are real-time ride matching and on-demand dispatching through sophisticated matching and scheduling programs. These systems function by examining where vehicles are, where the vehicles are heading, and how full the vehicles are at the time a ride request call is received. Through a series of decision trees, the computer matches the ride request to a vehicle and dispatches the ride order to the driver or, if no capacity exists on the vehicle, schedules the ride request to be filled by the first available vehicle. Providing transportation services in this flexible format may have significant and fundamental impacts on how demand-response and fixed-route services are provided.

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The Regional Transportation District in Denver, Colorado has implemented an AVL system for 833 fixed-route buses and 66 supervisor vehicles at an estimated cost of \$10.4 million. The Dallas, Texas Area Rapid Transit system is installing an AVL system for a total of 844 buses, 216 commuter coaches, 245 demand-response vans, and 300 supervisor vehicles. Similar systems are being developed in Milwaukee, Wisconsin and Baltimore, Maryland. The Baltimore, Maryland system will include signal pre-emption for buses running behind schedule. Colorado Springs, Colorado is in the process of implementation of an ITS/AVL systems at an estimated total cost of \$1.2 million over the next five years (\$60,000 in city funding and \$960,000 in FTA funding).

The existence of real-time dispatching and ride matching systems create the need for linking the public to the transit service. The “smart traveler system” provides a quick link by phone, kiosk, or computer to the dispatching system. A caller would request a ride. The system would then examine vehicle availability in response to the ride request and inform the caller where and when the rider would be met. The system may also suggest other mode choices available to the caller. The entire transaction need take only a few minutes. If an acceptable match cannot be made, the dispatching system may offer to fill the request with a taxi ride.



Several key conditions have evolved to make APTS applications more attractive. Technology has progressed to the point that the applications are finding their way into the general market and are becoming relatively commonplace. Currently, APTS applications are being used in many western states. These technological developments are the wave of the future for transportation systems. Such technological advancements improve transit system efficiency and quality of service in urban and rural areas. APTS applications are a realistic option for PanTran.

## **SUMMARY**

Chapter X has identified various capital needs that should be taken into consideration when providing public transit service. The capital items required for public transit service include vehicles, passenger amenities (such as shelters and benches), administrative and maintenance facilities, administrative computer programs, bicycle/pedestrian facilities, and advanced public transportation system technologies. The capital needs identified above should be considered when developing a more coordinated and efficient public transit system within the Eastern Panhandle Region.