7 Operating Costs

This chapter describes the build-up of the unit operating costs that were used in conjunction with the operating plans for assessing the total operating cost of each option. It is important to note that this study encompasses a wide variety of both technology and route options. Six different kinds of train technologies were evaluated including:

- Four Rail Technologies
  - 79-mph Conventional Diesel
  - 110-mph High-Speed Diesel
  - 150-mph Electric Locomotive-Hauled High-Speed Rail
  - 220-mph Electric Multiple-Unit (Self Propelled) High-Speed Rail
- Two Maglev Technologies
  - 125-mph Colorado Maglev (Linear Induction Motor)
  - 300-mph Transrapid (Linear Synchronous Motor)

At least two alignment options were evaluated for each corridor, including:

- I-25 Corridor
  - Greenfield
  - Existing Rail
- I-70 Corridor
  - High Grade 7 percent (I-70 Right-of-Way)
  - Low Grade 4 percent (Unconstrained)

An essential requirement is to maintain the consistency of the costing basis across all technologies and route alignment options. For example, because the 7 percent High-Grade option requires more powerful trains than does the 4 percent Low-Grade option, it would be appropriate to reflect this in higher per-mile equipment and energy costs. An apples-to-apples comparison is needed so that:

- Costs that depend on the propulsion/speed should reflect legitimate differences between technologies and routes.
- Costs that do not depend on propulsion/speed should remain the same across all technologies and routes.

In this chapter the character of the operating plan and equipment that optimizes each option will be described together with its unit operating costs. Some additional details are contained in the earlier methodology report.

The costing framework that was originally developed for the Midwest Regional Rail System (MWRRS) was adapted for use in this study. Following the MWRRS methodology, nine specific cost areas have been identified.[1] As shown in Exhibit 7-1, variable costs include equipment maintenance, energy and fuel, train and onboard (OBS) service crews, and insurance liability. Ridership influences marketing, and sales. Fixed costs include administrative costs, station costs, and track and right-of-way maintenance costs. Signals, communications and power supply are included in the track and right-of-way costs.

Exhibit 7-1: Operating Cost Categories and Primary Cost Drivers

Drivers		Cost Categories
Train Miles	→	Equipment Maintenance Energy and Fuel Train and Engine Crews Onboard Service Crews
Passenger Miles	→	Insurance Liability
Ridership and Revenue	→	Sales and Marketing
Fixed Cost	→	Service Administration Track and ROW Maintenance Station Costs

Operating costs developed for this study are consistent with unit operating costs from other recent studies. These costs were fine-tuned, then applied to the train-miles, number of stations, passenger volumes and other cost factors developed specifically for this study. Cost factors that vary by train technology, such as fuel usage and equipment maintenance, were developed from discussions with manufacturers and/or users of the technology and/or by cost benchmarking from both public and confidential sources. The cost development approach was used to fine-tune those items with the greatest potential variability and impact on the bottom line. Some unit costs, such as those for 110-mph diesel operations, are consistent with MWRRS costs brought up to $2008 through application of

[1] This corridor has no planned feeder bus services for which the rail service is financially responsible, and the treatment of operator profit will be discussed in parallel to Service Administration.

appropriate inflation adjustments. Other costs such as those for electric rail systems or maglev were developed from primary sources for this analysis or based on previous studies.

Operating costs can be categorized as variable or fixed. As described below, fixed costs include both Route and System overhead costs. Route costs can be clearly identified to specific train services but do not change much if fewer or additional trains were operated.

- **Variable costs** change with the volume of activity and are directly dependent on ridership, passenger miles or train miles. For each variable cost, a principal cost driver is identified and used to determine the total cost of that operating variable. An increase or decrease in any of these will directly drive operating costs higher or lower.
- **Fixed costs** are generally predetermined, but may be influenced by external factors, such as the volume of freight tonnage, or may include a relatively small component of activity-driven costs. As a rule, costs identified as fixed should remain stable across a broad range of service intensities. Within fixed costs are two sub-categories:
    - **Route** costs such as track maintenance, train control and station expense that, although fixed, can still be clearly identified at the route level.
    - **Overhead or System** costs such as headquarters management, call center, accounting, legal, and other corporate fixed costs that are shared across routes or even nationally. A portion of overhead cost (such as direct line supervision) may be directly identifiable but most of the cost is fixed. Accordingly, assignment of such costs becomes an allocation issue that raises equity concerns. These kinds of fixed costs are handled separately.

Operating costs have been developed based on the following premises:

- Based on results of recent studies, a variety of sources including suppliers, current operators' histories, testing programs and prior internal analysis from other passenger corridors were used to develop the cost data. However, as the rail service is implemented, actual costs will be subject to negotiation between the passenger rail authority and the contract rail operator(s).
- Freight railroads will maintain the track and right-of-way that they own, but ultimately, the actual cost of track maintenance will be resolved through negotiations with the railroads. For this study a track maintenance cost model was used that reflects actual freight railroad cost data.
- Maintenance of train equipment will be contracted out to the equipment supplier.
- Train operating practices follow existing work rules for crew staffing and hours of service. Operating expenses for train operations, crews, management and supervision were developed through a bottoms-up staffing approach based on typical passenger rail organizational needs.

The costing framework has been validated with recent operating experience based on publicly available data from other sources, particularly the Northern New England Passenger Rail Authority's (NNEPRA) *Downeaster* costs and data on Illinois operations that was provided by Amtrak. It has been brought to a $2008 costing basis and additional cost categories, such as for electrification, have been added into the model.

As background, the MWRRS costing framework was developed in conjunction with nine states that comprised the MWRRS steering committee and with Amtrak. In addition, freight railroads, equipment manufacturers and others provided input to the development of the costs.

The original concept for the MWRRS was for development of a new service based on operating methods directly modeled after state-of-the-art European rail operating practice. Along with anticipated economies of scale, modern train technology could reduce operating costs when compared to existing Amtrak practice. In the original 2000 MWRRS Plan, European equipment costs were measured at 40 percent of Amtrak's costs. However, in the final MWRRS plan that was released in 2004, train-operating costs were significantly increased to a level that is more consistent with Amtrak's current cost structure. However, adopting an Amtrak cost structure for financial planning does not suggest that Amtrak would actually be selected for the corridor operation. Rather, this selection increases the flexibility for choosing an operator without excluding Amtrak, because multiple operators and vendors will be able to meet the broader performance parameters provided by this conservative approach.

The RMRA analysis has been conducted using 2008 constant dollars.

7.1 Variable Costs

These costs include those that directly depend on the number of train-miles operated. They include train equipment maintenance, train crew cost, fuel and energy, onboard service, and insurance costs.

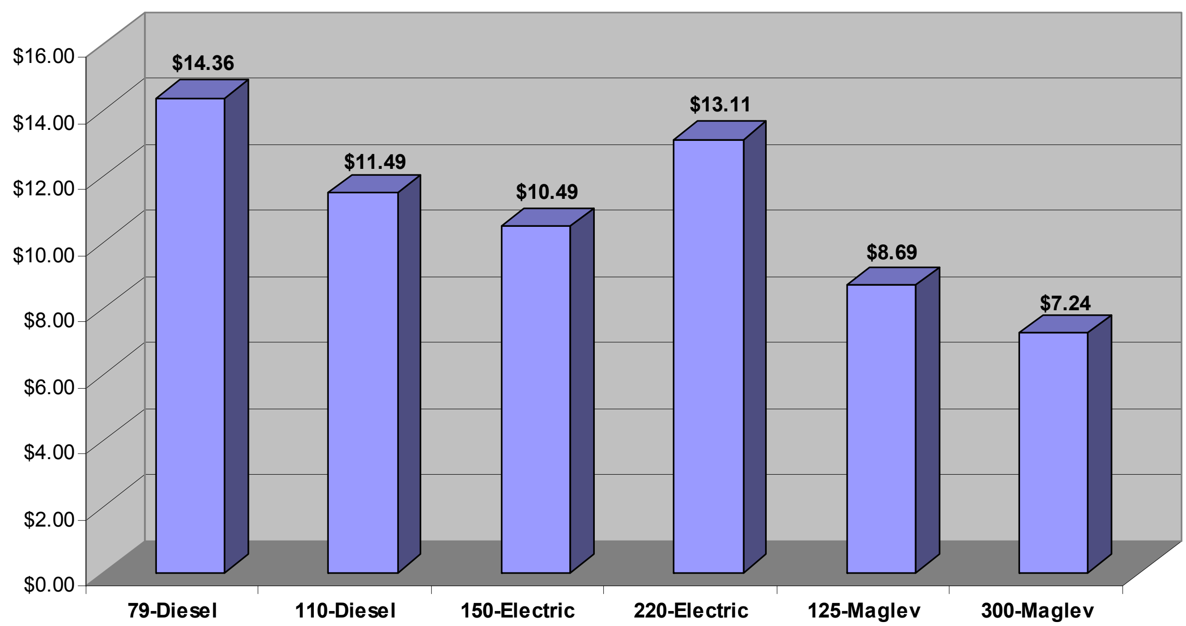
7.1.1 Train Equipment Maintenance

Equipment maintenance costs include all costs for spare parts, labor and materials needed to keep equipment safe and reliable. The costs include periodical overhauls in addition to running maintenance. It also assumes that facilities for servicing and maintaining equipment are designed specifically to accommodate the selected train technology. This arrangement supports more efficient and cost-effective maintenance practices. Acquiring a large fleet of trains with identical features and components, allows for substantial savings in parts inventory and other economies of scale. In particular, commonality of rolling stock and other equipment will standardize maintenance training, enhance efficiencies and foster broad expertise in train and system repair.

The MWRRS study developed a cost of $9.87 per train mile for a 300-seat train in $2002. This cost was increased to $11.49 per train mile in $2008. Available evidence suggests that the maintenance cost for an electric train should be about 9 percent cheaper per equivalent seat-mile than that of a diesel train leading to a unit cost of $10.49 per train-mile for the 150-mph locomotive-hauled electric train used on the 4 percent gradients. The higher-powered 220-mph electric train needed for 7 percent gradients will need more on-board electrical equipment, transformers and traction motors that increases its operating cost up to $13.11 per train-mile.

Equipment maintenance cost for Maglev vehicles were developed from information provided by Transrapid and other sources. Available data indicates that Maglev vehicle maintenance costs should be substantially lower than for conventional rail vehicles. However the 125-mph Colorado Maglev has the LIM motor on board the vehicle, which adds to the electrical complexity of that LIM vehicle as opposed to the Transrapid, which has the LSM motor in the guideway. The need for maintaining this additional on-board electrical equipment is reflected in a higher equipment cost for the 125-mph LIM vehicle as compared to the 300-mph LSM Transrapid. All equipment maintenance unit costs used for this evaluation are summarized in Exhibit 7-2.

Exhibit 7-2: Equipment Maintenance Cost per Mile ($2008)



7.1.2 Train and Engine Crew Costs

The train operating crew incurs crew costs. Following Amtrak staffing policies, the operating crew would consist of an engineer, a conductor and an assistant conductor and is subject to federal Hours of Service regulations. Costs for the crew include salary, fringe benefits, training, overtime and additional pay for split shifts and high mileage runs. An overtime allowance is included as well as scheduled time-off, unscheduled absences and time required for operating, safety and passenger handling training. Fringe benefits include health and welfare, FICA and pensions. The cost of employee injury claims under FELA is also treated as a fringe benefit for this analysis. The overall fringe benefit rate was calculated as 55 percent. In addition, an allowance was built in for spare/reserve crews on the extra board. Costing of train crews was based on Amtrak's 1999 labor agreement, adjusted for inflation to 2008.

Any intercity service needs the safety, fare collection and customer service functions performed by the on-board train crew. Regarding the train operator, it is equally possible to automate either a conventional rail system or a maglev, provided access to the right-of-way is equally controlled. Some previous maglev studies have proposed to eliminate staffing on-board trains and instead place their staffing in stations. This could be appropriate for an extremely high-volume, short-haul maglev such as might be found in urban transit corridors, but for a long haul, lower volume intercity application it is more appropriate to place personnel on board the trains rather than in the stations. Since the rail and maglev modes are equal in their ability to be automated, an "apples to apples" comparison of Rail versus Maglev options requires consistency in the train and station staffing assumptions.

Crew costs depend upon the level of train crew utilization, which is largely influenced by the structure of crew bases and any prior agreements on staffing locations. Train frequency strongly influences the amount of held-away-from-home-terminal time, which occurs if train crews have to stay overnight in a hotel away from their home base. Since train schedules have continued to evolve throughout the lifetime of this study and a broad range of service frequencies and speeds have been evaluated, a parametric approach was needed to develop a system average per train mile rate for crew costs. Such an average rate necessarily involves some approximation, but to avoid having to reconfigure a detailed crew-staffing plan whenever the train schedules change, an average rate is necessary and appropriate for a planning-level study.

For this study, an intermediate value of $4.58 per train mile was selected for 110-mph scenarios. This is a moderate level of crew cost that includes the need for some away-from-home layover. 79-mph scenarios cost $6.13 per train-mile because of poor crew utilization in these low-frequency scenarios. With trains operating less frequently there is less opportunity to return crews to their home base on the same day, leading to more split shifts and overnight layovers. The 220-mph scenarios used $4.28 per train mile, reflecting operating efficiencies related both to higher speeds and more frequent trains, both of which tend to reduce the need for away-from-home layovers.

7.1.3 Fuel and Energy

Both the ridership and operating cost models are based on fuel costs that were in effect during the base year of 2008 and that formed the basis of the demand model calibration. The assumed diesel fuel cost on the operating side is consistent with the level of gasoline prices that were assumed for development of the demand forecasts. The fuel price spikes of 2007 and 2008 show the difficulty of predicting short-term energy prices. However, economists are in more general agreement that long-term energy prices are only going in one direction: up.

A consumption rate of 2.42 gallons/mile was estimated for a 110-mph 300-seat train, based upon nominal usage rates of all three technologies considered in Phase 3 of the MWRRS Study. Assuming $2.52 a gallon for diesel fuel per a recent RTD study, this translates into a cost of $6.10 per train mile, roughly doubling the cost of diesel fuel as compared to the earlier MWRRS study.

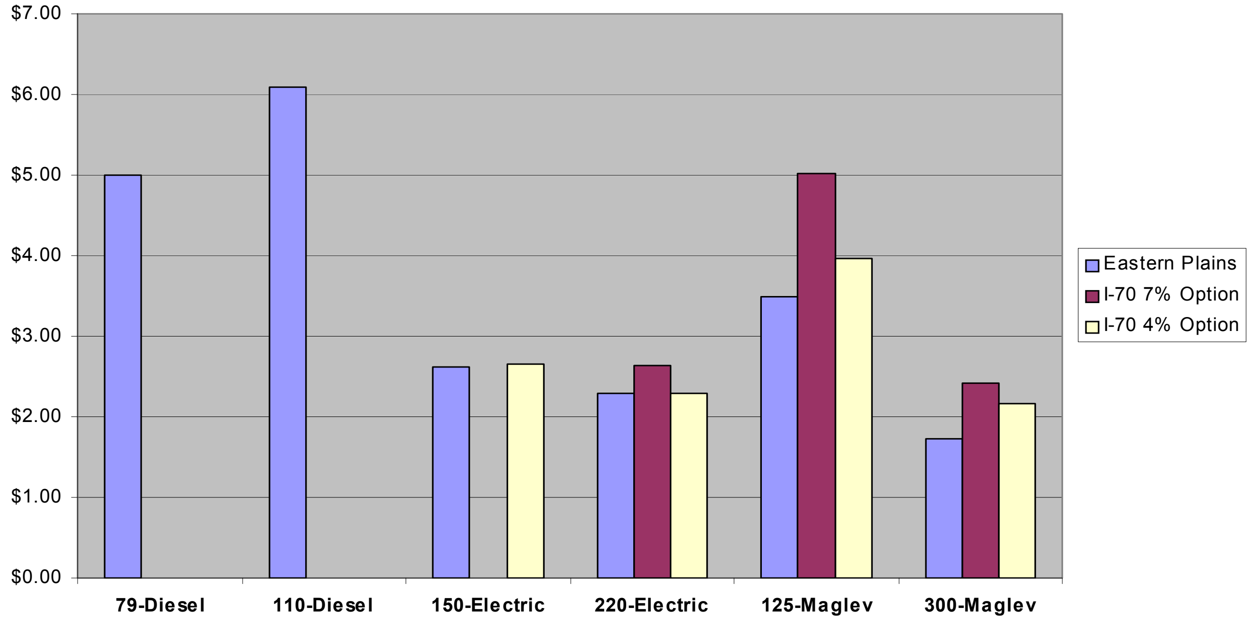
However, electric traction has an advantage over diesel since it can be powered from any energy source, not just petroleum-based fuel. Even taking typical peaking demands into account, electric energy is typically less expensive than diesel fuel. The comparable cost for the 150-mph locomotive-hauled electric train was just $2.61 per train mile as compared to $6.10 for the diesel. The 220-mph electric multiple unit is even more efficient at $2.29 per train mile when operating on the I-25 corridor in the eastern plains. All electric costs include the Peak Usage charge, which for electric rail systems is significant, usually doubling the overall electric cost.

For costing electric train or maglev operations in the mountains, an allowance must be made for energy recapture during regenerative braking. That is, some of the energy used going uphill can be turned back into electricity going downhill, and fed back into the overhead electric wire. Clearly more energy will be used overall due to operation on heavy grades, but the ability to regenerate power offsets at least a part of the added cost.

Both electric trains and maglev vehicles have the ability for regenerative braking. However they are not equally efficient at doing it. Rail vehicles tend to be the heaviest, but their traction motors have a very high electrical efficiency because of the small air gap. LSM maglev vehicles are very light compared to rail vehicles and have good electrical efficiency as well. However, LIM maglev vehicles such as the proposed Colorado Maglev have additional weight due to having the linear motor on board the vehicle; additionally the electrical efficiency of LIM propulsion is only in the 70 percent range for LIM as opposed to mid-90 percent for LSM and high-90 percent for rail. As a result, the LIM vehicle wastes a lot of electrical energy both going uphill and downhill, turning that energy into heat.

This result is shown in Exhibit 7-3 where the 220-mph electric train has a cost of $2.63 per mile for operating in the mountains, only slightly more than for operating on level ground, due to this vehicle's high efficiency in regenerative braking mode. The 300-mph maglev has a slightly lower cost of $2.42 per mile, although the LSM propulsion is slightly less efficient in recapturing energy, the maglev vehicle is much lighter, so it consumes less energy overall. However, the 125-mph LIM maglev costs $5.02 per mile in mountainous territory, approximately double the energy consumption of either the electric train or LSM maglev, due to the poor electrical efficiency of the LIM drive.

Exhibit 7-3: Energy and Fuel - Cost per Mile ($2008)



7.1.4 Onboard Services (OBS)

Onboard service (OBS) costs are those expenses for providing food service onboard the trains. OBS adds costs in three different areas: equipment, labor and cost of goods sold. Equipment capital and operating cost is built into the cost of the trains and is not attributed to food catering specifically. Small 200-seat trains cannot afford a dedicated dining or bistro car. Instead, an OBS employee or food service vendor would move through the train with a trolley cart, offering food and beverages for sale to the passengers.

The goal of OBS franchising should be to ensure a reasonable profit for the provider of on-board services, while maintaining a reasonable and affordable price structure for passengers. The key to attaining OBS profitability is selling enough products to recover the train mile related labor costs. If small 200-seat trains were used for start-up, given the assumed OBS cost structure, even with a trolley cart service the OBS operator will be challenged to attain profitability. However, the expanded customer base on larger 300-seat trains can provide a slight positive operating margin for OBS service. 400-seat electric trains should provide a comfortable positive profit margin for the OBS operator.

Because the trolley cart has been shown to double OBS revenues, it can result in profitable OBS operations in situations where a bistro-only service would be hard-pressed to sell enough food to recover its costs. While only a limited menu can be offered from a cart, the ready availability of food and beverages at the customer's seat is a proven strategy for increasing sales. Many customers appreciate the convenience of a trolley cart service and are willing to purchase food items that are brought directly to them. While some customers prefer stretching their legs and walking to a bistro car, other customers will not bother to make the trip.

The cost of goods sold is estimated as 50 percent of OBS revenue, based on Amtrak's route profitability reports. Labor costs, including the cost of commissary support and OBS supervision, have been estimated at $2.38 per train mile for 110-mph service, declining to $1.66 per train mile because of better crew utilization in the 220-mph scenario. This cost is generally consistent with Amtrak's level of wages and staffing approach for conventional bistro car services. However, this Business Plan recommends that an experienced food service vendor provide food services and use a trolley cart approach.

A key technical requirement for providing trolley service is to ensure the doors and vestibules between cars are designed to allow a cart to easily pass through. Since trolley service is a standard feature on most European railways, most European rolling stock is designed to accommodate the carts. Although convenient passageways often have not been provided on U.S. equipment, the ability to support trolley carts is an important equipment design requirement for the planned service.

7.1.5 Insurance Costs

Liability costs were estimated at 1.3¢ per passenger-mile, the same rate that was assumed in the earlier MWRRS study brought to $2008. Federal Employees Liability Act (FELA) costs are not included in this category but are applied as an overhead to labor costs.

The Amtrak Reform and Accountability Act of 1997 (§161) provides for a limit of $200 million on passenger liability claims. Amtrak carries that level of excess liability insurance, which allows Amtrak to fully indemnify the freight railroads in the event of a rail accident. This insurance protection has been a key element in Amtrak's ability to secure freight railroad cooperation. In addition, freight railroads perceive that the full faith and credit of the United States Government is behind Amtrak, while this may not be true of other potential passenger operators. A recent General Accounting Office (GAO) review[2] has concluded that this $200 million liability cap applies to commuter railroads as well as to Amtrak. If the GAO's interpretation is correct, the liability cap may also apply to potential Colorado rail franchisees. If this liability limitation were in fact available to potential franchisees, it would be much easier for any operator to obtain insurance that could fully indemnify a freight railroad at a reasonable cost. It is recommended that the Rocky Mountain Rail Authority seek qualified legal advice on this matter.

[2] See: http://www.gao.gov/highlights/d04240high.pdf

7.2 Fixed Route Costs

This cost category includes those costs that, while largely independent of the number of train-miles operated, can still be directly associated to the operation of specific routes. It includes such costs as track maintenance, which varies by train technology, and station operations.

7.2.1 Track and Right-of-Way Costs

Currently, it is industry practice for passenger train operators providing service on freight-owned rights-of-way to pay for track access, dispatching and track maintenance. The rates for all of these activities will ultimately be based upon a determination of the appropriate costs that result from negotiations between the parties. The purpose here is to provide estimates based on the best available information; however, it is important to recognize that this study is a feasibility-level analysis and that as the project moves forward, additional study and discussions with the railroads will be needed to further refine these costs. Both capital and operating costs will be estimated.

To accommodate passenger trains, Colorado rail corridors would need a substantial increase in capacity. Once constructed, these improvements will need to be maintained to FRA standards required for reliable and safe operations. The costing basis assumed in this report is that of *incremental* or *avoidable* costs. Avoidable costs are those that are eliminated or saved if an activity is discontinued. The term *incremental* is used to reference the change in costs that results from a management action that increases volume, whereas *avoidable* defines the change in costs that results from a management action that reduces volume.

The following cost components are included within the Track and Right-of-Way category:

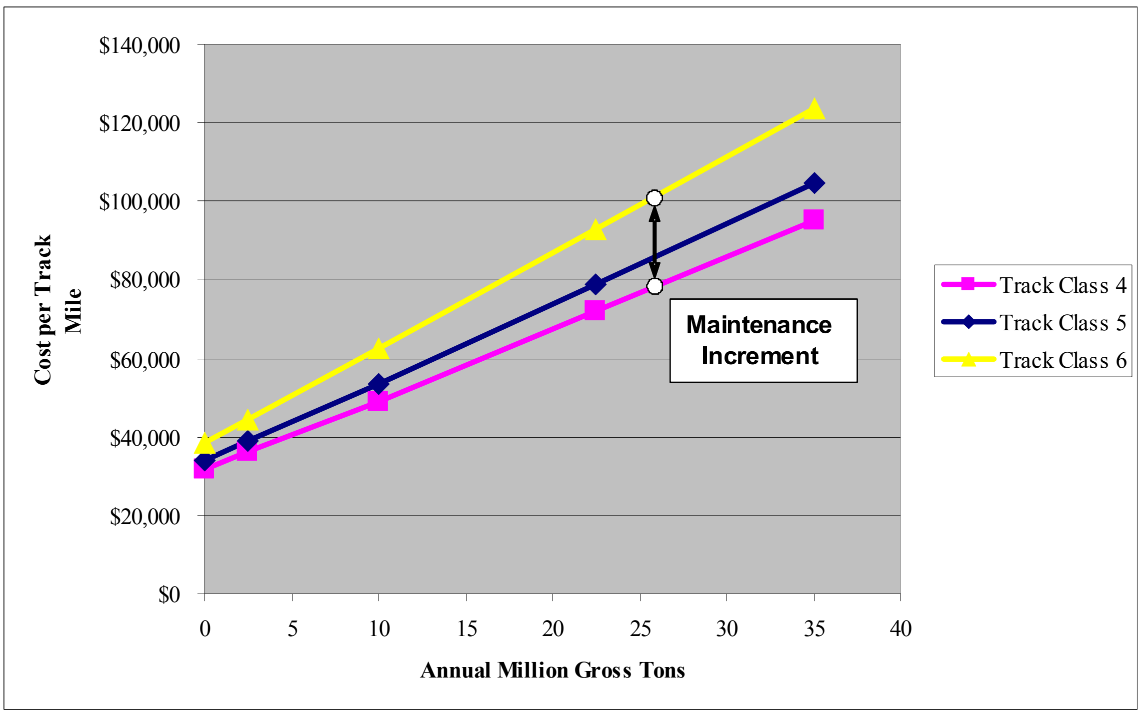
- **Track Maintenance Costs.** Costs for track maintenance are estimated based on Zeta-Tech's January 2004 draft technical monograph *Estimating Maintenance Costs for Mixed High-Speed Passenger and Freight Rail Corridors*.[3] Zeta-Tech costs have been adjusted for inflation to $2008. However, Zeta-Tech's costs are conceptual and are still subject to negotiation with the freight railroads.
- **Dispatching Costs and Out-of-Pocket Reimbursement.** Passenger service must also reimburse a freight railroad's added costs for dispatching its line, providing employee efficiency tests and for performing other services on behalf of the passenger operator. These costs are included as an additive to Track and Right-of-Way Maintenance costs.
- **Costs for Access to Track and Right-of-Way.** Access fees, particularly train mile fees incurred as an operating expense, are specifically excluded from this calculation. Any such payments would have to be calculated and negotiated on a route-specific and railroad-specific basis. Such a calculation would have to consider the value of the infrastructure

[3] Zeta-Tech, a subsidiary of Harsco (a supplier of track maintenance machinery) is a rail consulting firm who specializes in development of track maintenance strategies, costs and related engineering economics.

improvements made to the corridor for balancing up-front capital with ongoing operating payments.[4]

Exhibit 7-4 shows the conceptual relationship between track maintenance cost and total tonnage that was calibrated from the earlier Zeta-Tech study. It shows a strong relationship between tonnage, FRA track class (4 through 6, corresponding to a 79-mph to 110-mph track speed) and maintenance cost. At low tonnage, the cost differential for maintaining a higher track class is not very large, but as tonnage grows, so too does the added cost. For shared track, if freight needs only Class 4 track, the passenger service would have to pay the difference, called the "maintenance increment", which for a 25 MGT line as shown in Exhibit 7-4, would come to about $25,000 per mile per year. The required payment to reimburse a freight railroad for its added track cost would be less for lower freight tonnage, more for higher freight tonnage.

Exhibit 7-4: Track Maintenance Cost Function (in $2002)



Please note that Exhibit 7-4 shows that the cost of shared track depends strongly on the level of *freight* tonnage, since the passenger trains are relatively lightweight and do not contribute much to the total tonnage, In fact, following the Zeta-Tech methodology, the "maintenance increment" is calculated based on *freight tonnage only*, since a flat rate of $1.56 per train mile as used in the Zeta-Tech report was already added to reflect the direct cost of added passenger tonnage regardless of

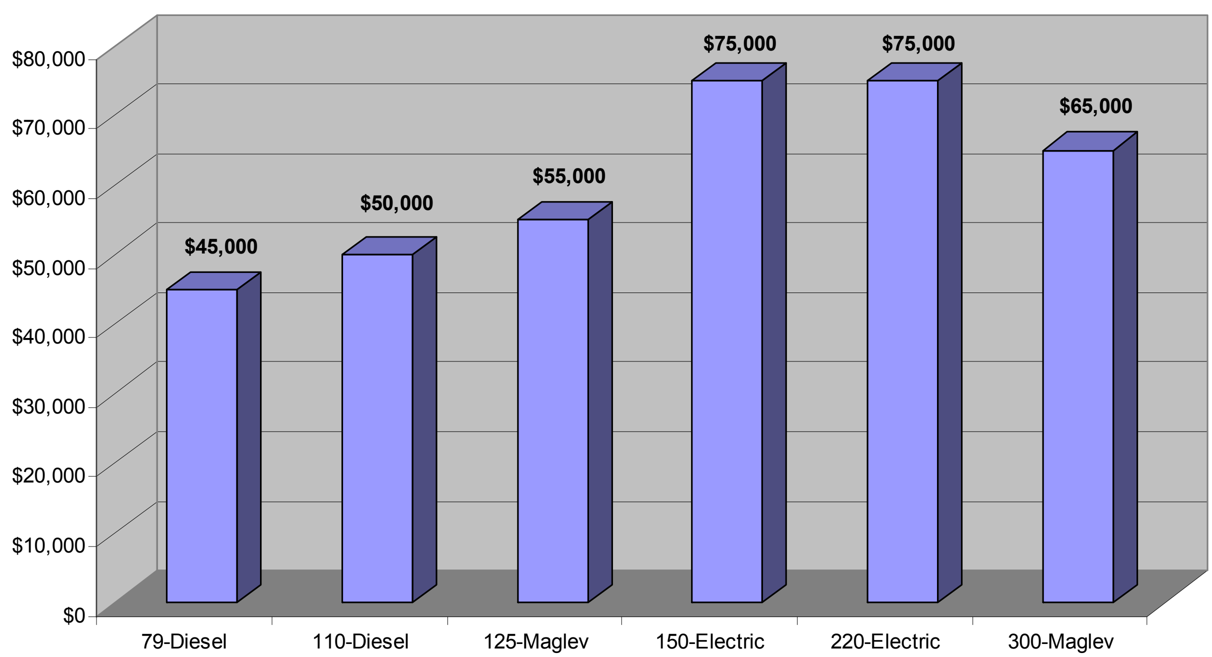
[4] For 110-mph service, the level of infrastructure improvements to the corridor called for in this study should provide enough capacity to allow superior on-time performance for both freight and passenger operations

track class. This cost, which was developed by Zeta-Tech's TrackShare® model, includes not only directly variable costs, but also an allocation of a freight railroad's fixed cost. Accordingly, it complies with the Surface Transportation Board's definition of "avoidable cost." An allowance of 39.5¢ per train-mile was added for freight railroad dispatching and out-of-pocket costs.

The same cost function shown in Exhibit 7-4 can also be used for costing dedicated passenger track. With dedicated track, the passenger system is assumed to cover the entire cost for maintaining its own track. (Freight would then have to reimburse the passenger operator on a car-mile basis for any damage it causes to the passenger track.) Because passenger train tonnage is very low however, it can be seen that the cost differential between Class 4, 5 and 6 track is very small. Adjusting Zeta-Tech's $2002 costs shown in Exhibit 7-4 up to $2008, the average annual cost per track-mile for maintaining dedicated Class 4 track is about $45,000; the cost for Class 6 track rises to $50,000. Adding $25,000 per track-mile for overhead electric catenary, the overall maintenance cost rises to about $75,000 per track mile per year.

According to the data furnished by Transrapid, maglev infrastructure should cost less to maintain than an equivalent rail guideway. Compared to $75,000 per track mile for electrified railroad, the 300-mph Transrapid guideway is estimated to cost only $65,000 per mile per year to maintain. Since the 125-mph maglev guideway with LIM propulsion is much simpler than Transrapid's LSM guideway (which has extensive electrical coils in the track) the 125-maglev guideway cost was reduced to $55,000 per mile. These results in terms of guideway maintenance cost are summarized in Exhibit 7-5.

Exhibit 7-5: Guideway Maintenance – Cost per Track Mile ($2008)



In addition to an *operating* component of track maintenance cost (which is shown in Exhibit 7-4) the track cost methodology also identifies a *capital* cost component. For track maintenance:

- *Operating costs* cover expenses needed to keep existing assets in service and include both surfacing and a regimen of facility inspections.
- *Capital costs* are those related to the physical replacement of the assets that wear out. They include expenditures such as for replacement of rail and ties, but these costs are not incurred until many years after construction. In addition, the regular maintenance of a smooth surface by reducing dynamic loads actually helps extend the life of the underlying rail and tie assets. Therefore, capital maintenance costs are gradually introduced using a table of ramp-up factors provided by Zeta-Tech (Exhibit 7-6). A normalized capital maintenance level is not reached until 20 years after completion of the rail upgrade program.

Exhibit 7-6: Capital Cost Ramp-Up Following Upgrade of a Rail Line

Year	% of Capital Maintenance	Year	% of Capital Maintenance
0	0%	11	50%
1	0%	12	50%
2	0%	13	50%
3	0%	14	50%
4	20%	15	75%
5	20%	16	75%
6	20%	17	75%
7	35%	18	75%
8	35%	19	75%
9	35%	20	100%
10	50%		

For development of the Business Plan, only the operating component of track maintenance cost is treated as a direct operating expense. Capital maintenance costs are incorporated into the Financial Plan and into the Benefit Cost analysis. Because these capital costs do not start occurring until rather late in the project life, usually they have a very minor effect on the Benefit Cost calculation. These costs can be financed using direct capital grants or from surplus operating cash flow. The latter option has been assumed in this study. Accordingly, maintenance capital expenses only reduce the net cash flow generated from operations; they do not affect the operating ratio calculations.

7.2.2 Station Operations

A simplified fare structure, heavy reliance upon electronic ticketing and avoidance of a reservation system will minimize station personnel requirements. Station costs include personnel, ticket machines and station operating expenses.

- Staffed stations will be assumed at major stations. All stations were assumed open for two shifts. The cost for the staffed stations includes eight positions at each new location, costing $600,000 per year, in $2008.
- The cost for unstaffed stations covers the cost of utilities, ticket machines, cleaning and basic facility maintenance, costing $75,000 per year, in $2008. (These costs are also included in the staffed station cost.) Volunteer personnel such as Traveler's Aid, if desired could staff these stations.

This stations cost is practically independent of the number of trains operated or their speed, so running the largest number of trains at the highest speed possible generates the best economies of scale. The exact number of stations depends on the route alignment options that are ultimately selected for the system, but total station costs for the full system are likely to fall in the range of $12-14 million annually.

7.3 System Overhead Costs

The category of System Overhead largely consists of Service Administration or management overheads, covering such needs as the corporate procurement, human resources, accounting, finance and information technology functions as well as call center administration. A stand-alone administrative organization appropriate for the operation of a corridor system was developed for the MWRRS and later refined for the Ohio Hub studies. This organizational structure, which was developed with Amtrak's input and had a fixed cost of $8.9 million plus $1.43 per train-mile (in $2002) for added staff requirements as the system grew. Inflated to $2008, this became $10.3 million plus $1.53 per train mile.

However, the Sales and Marketing category also has a substantial fixed cost component for advertising and call center expense, adding another $2.7 million per year fixed cost, plus variable call center expenses of 66¢ per rider, all in $2008.[5] Finally, credit card and travel agency commissions are all variable: 1.8 percent and 1 percent of revenue, respectively. Therefore, the overall financial model for a Stand-alone organization therefore has $13.0 million ($10.3 + $2.7 million) annually in fixed cost for administrative, sales and marketing expenses. In addition, the system operator was allowed a 10 percent markup on certain direct cost items as a contribution to operator profit.

For operations that are too small to support their own stand-alone management structure, a benchmarking exercise concluded that an allocation share of $5 per train-mile contribution to fixed costs would be adequate under most circumstances, until the corridor system grows to a point where it is large enough that it can start supporting its own stand-alone administrative cost structure.

[5] In the MWRRS cost model, call center costs were built up directly from ridership, assuming 40 percent of all riders call for information, and that the average information call will take 5 minutes for each round trip. Call center costs, therefore, are variable by rider and not by train-mile. Assuming some flexibility for assigning personnel to accommodate peaks in volume and a 20 percent staffing contingency, variable costs came to 57¢ per rider. These were inflated to 66¢ per rider in $2008.

7.4 Key Cost Results

An apples-to-apples comparison of maglev to rail cost has concluded, based on the best available information, that propulsion-dependent operating costs for a 300-mph maglev would be generally lower than that for a rail system; these include energy, vehicle maintenance and guideway maintenance costs. Other maglev costs were treated as equivalent to a rail system, including Administration, Train and On Board Crew, Stations and Insurance costs.

Exhibit 7-7 shows the total annual operating cost breakdown for the full system options. Each technology option has a particular route alignment structure associated with it as defined in Chapter 3, and operating plan as described in Chapter 5.

Exhibit 7-7: Total Annual Operating Cost Breakdown by Technology

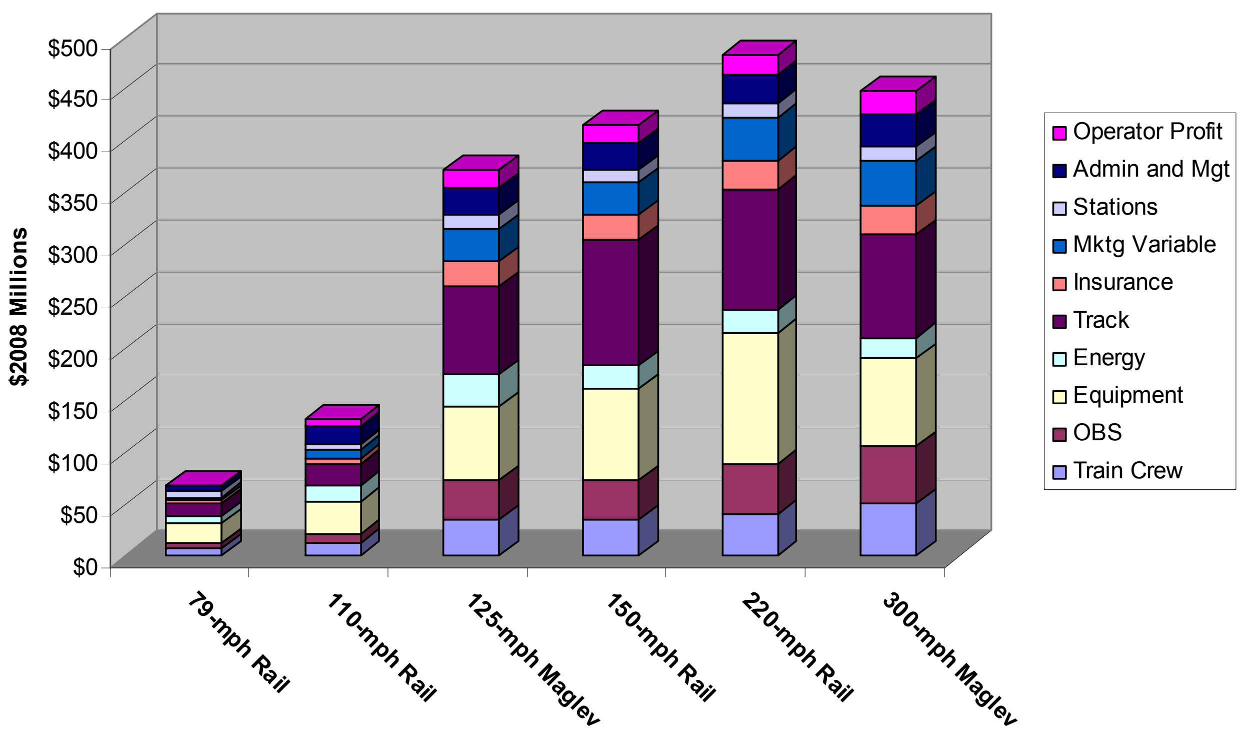


Exhibit 7-8 shows the average cost per train mile. It shows that maglev options tend to have slightly lower average costs than do the rail options. Rail costs are all remarkably close to $50 per train-mile. The 220-mph electric train however, has a much higher earning capacity than does the 110-mph diesel train because it is a larger train and because it goes faster, the 220-mph train can support a higher revenue yield per passenger-mile. This explains one of the main reasons why higher speed systems tend to produce better financial operating results than do lower speed systems.

Exhibit 7-8: Average Cost per Train Mile by Technology