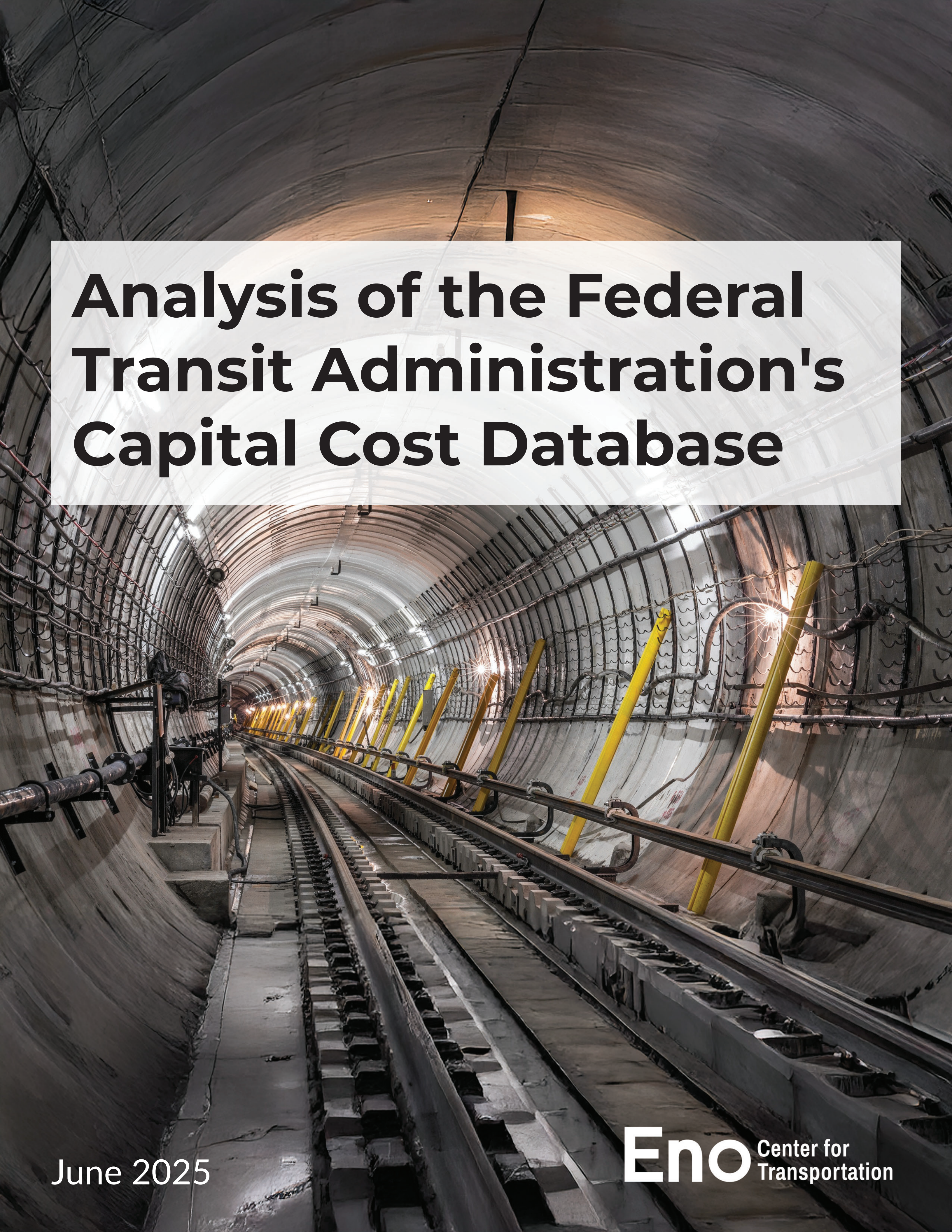

Analysis of the Federal Transit Administration's Capital Cost Database

June 2025

Eno Center for Transportation

Eno Center for Transportation

NYU Marron Institute of Urban Management

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Introduction

The Federal Transit Administration's (FTA) Capital Cost Database (the Database) provides a detailed accounting of federally-funded domestic transit projects' capital costs over the last 40 years. During the last year, the project team, made up of NYU Marron's Eric Goldwyn, Alon Levy, and Elif Ensari and Eno Center's Philip Plotch, reviewed the Database, the Eno Center's Transit Construction Cost database, NYU Marron's Transit Costs Project's database, relevant literature, and conducted interviews and virtual meetings with FTA staff, cost estimators, and transit agency employees primarily drawn from capital construction departments at four transit agencies who have experience using the Database. This report was undertaken for the FTA.

Origins, Purpose, and Use of the Capital Cost Database

The FTA Capital Cost Database was designed to help grantees develop rough order of magnitude cost estimates. The database uses the following eight Standard Cost Categories, which ensures a consistent format for the reporting, estimating, and managing of capital costs for large capital projects receiving FTA funds.

10. Guideway & Track Elements
20. Stations, Stops, Terminals, Intermodal
30. Support Facilities: Yards, Shops, Administrative Buildings
40. Sitework & Special Conditions
50. Systems
60. Right of Way, Land, Existing Improvements
70. Vehicles
80. Professional Services

Each of these eight categories are also broken down in subcategories. For example, Vehicles is broken down into: light rail (70.01), heavy rail (70.02), commuter rail (70.03), bus (70.04), other (70.05), non-revenue vehicles (70.06), and spare parts (70.07). These subcategories are further broken down. For example, within the bus subcategory are small bus (70.041), standard 40-foot bus (70.042), articulated bus (70.043), and unspecified (70.0444).

Since these categories are used for reporting and tracking costs throughout the life of Capital Investment Grant (CIG) projects, the database is available as a resource as projects develop from conceptual design to closeout. The Database was first published in 2010, and is now in its fourth iteration. It currently includes projects completed between the early 1980s and 2020.

The data is presented in two formats, a Microsoft Access database and a comma-separated values (CSV) file. The Access database provides total and unit costs data by Standard Cost Categories. It includes information that is not in the CSV file such as a narrative description and key project development dates. The database can be used to build a high-level cost model and data can be sorted by date and mode.

The CSV file reports the Standard Cost Categories' total dollar values, units, unit costs, and the midyear of construction. The project team used data from the CSV to build its website's tables, graphs, and charts. As of May 2024, the team's tables and graphics can be accessed at: https://transitcosts.com/fta-database-analysis-visuals/

The Database consists of unit costs reported for unique Standard Cost Categories across eight categories. The Standard Cost Categories date back to 2005, and are used by CIG projects to populate the Standard Cost Category Workbook, which is used as a project management tool to establish a consistent format for the reporting, estimating, and managing of capital costs for CIG projects. By standardizing how costs are cataloged, data from one project can be compared to another, assuming the data is accurate.

Some Project Management Oversight Contractors (PMOC) use the database as a preliminary check on the grantees' cost estimates over the life of the project. "Oversight Procedure 33 – Capital Cost Estimate Review," (US DOT p.7, 2015) explains, however, that the database "should not be used exclusively or predominantly as the PMOC's Cost Estimating review tool, it should be consulted with as it allows for a comparison to historical projects, having generally similar characteristics." The Database is one tool that PMOCs use to determine the quality of cost estimates and track variances.

"TCRP Report 138: Estimating Soft Costs for Major Public Transportation Fixed Guideway Projects" (2010) is the earliest report to reference the database, and was the impetus for the FTA to refine its contents and make it available to the public. The TCRP authors state that the database can help grantees more accurately estimate soft costs/professional services as projects move through the project development phase. Since soft costs range between 9 percent and 66 percent of Standard Cost Categories 10 through 50 in the current data, exclusive of outliers, estimating those costs accurately is significant for projects that cost from hundreds of millions to billions of dollars.[1] Most relevant to the current study, the report recognizes that there is a proportional relationship between hard costs and soft costs; thus, estimating hard costs accurately helps estimate soft costs accurately.

[1] We calculate the soft cost percentage by summing the total costs of categories 10 through 50 and dividing by category 80's costs.

While the Database is perhaps most useful during the project development phase, grantees have also turned to it during construction to help guide value engineering efforts, such as "right sizing" station designs, vehicle maintenance facilities, and reconfiguring the right of way. Using the Database as a benchmarking tool provides grantees an opportunity to compare their projects against the entire Database or a more appropriate subset of it.

The following pages contain three images.

- Image 1 displays the cost per mile of 49 projects in the database. These include light rail, heavy rail, commuter rail, bus rapid transit, and trolley projects. Note that given space constraints, only a limited number of project names can be displayed. Also note that five projects were excluded from this graph as indicated later in this report.
- Image 2 shows the cost of 27 light rail projects and separates the cost by the eight cost categories.
- Image 3 shows the cost of 15 heavy rail projects and separates the cost by the eight cost categories.

Image 1: Scatterplot of the sum of the eight Standard Cost Categories (in 2021 inflation-adjusted dollars)

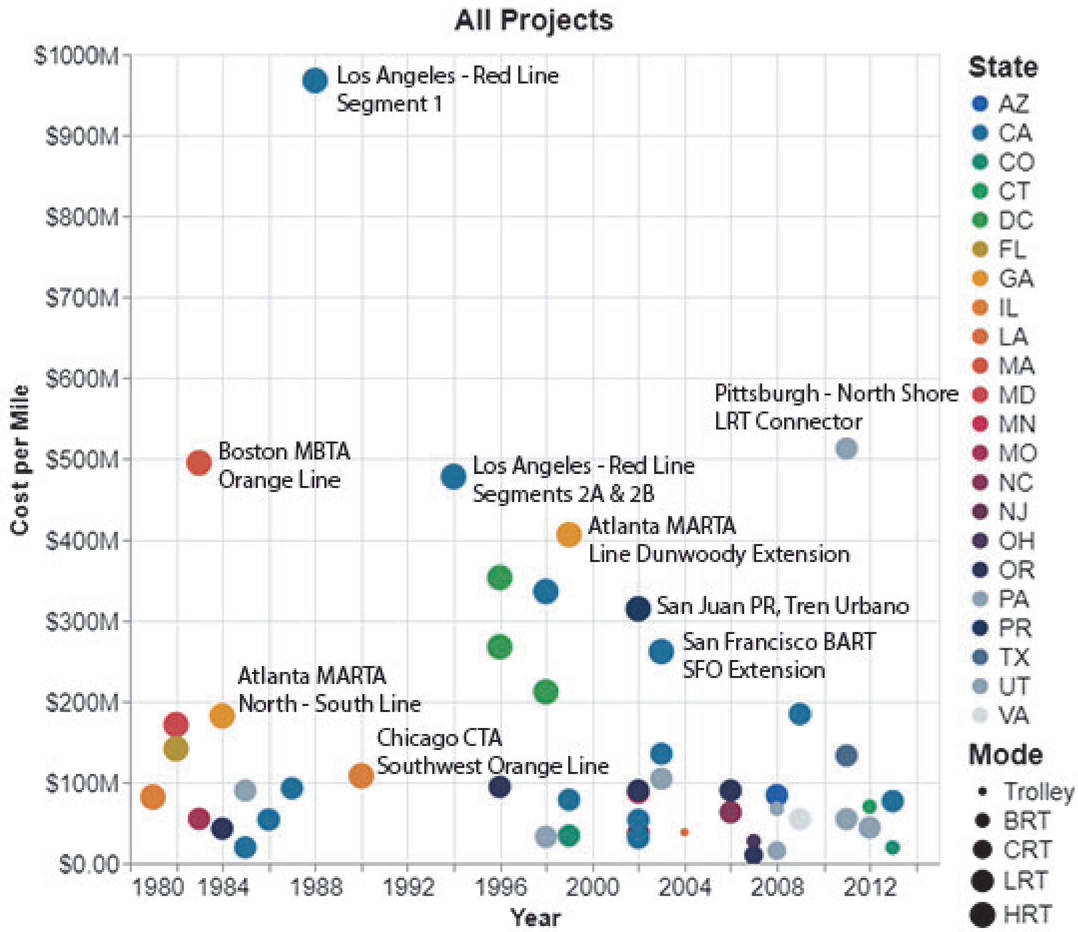


Image 2: Light Rail project costs by mode and Standard Cost Categories (in 2021 inflation-adjusted dollars)

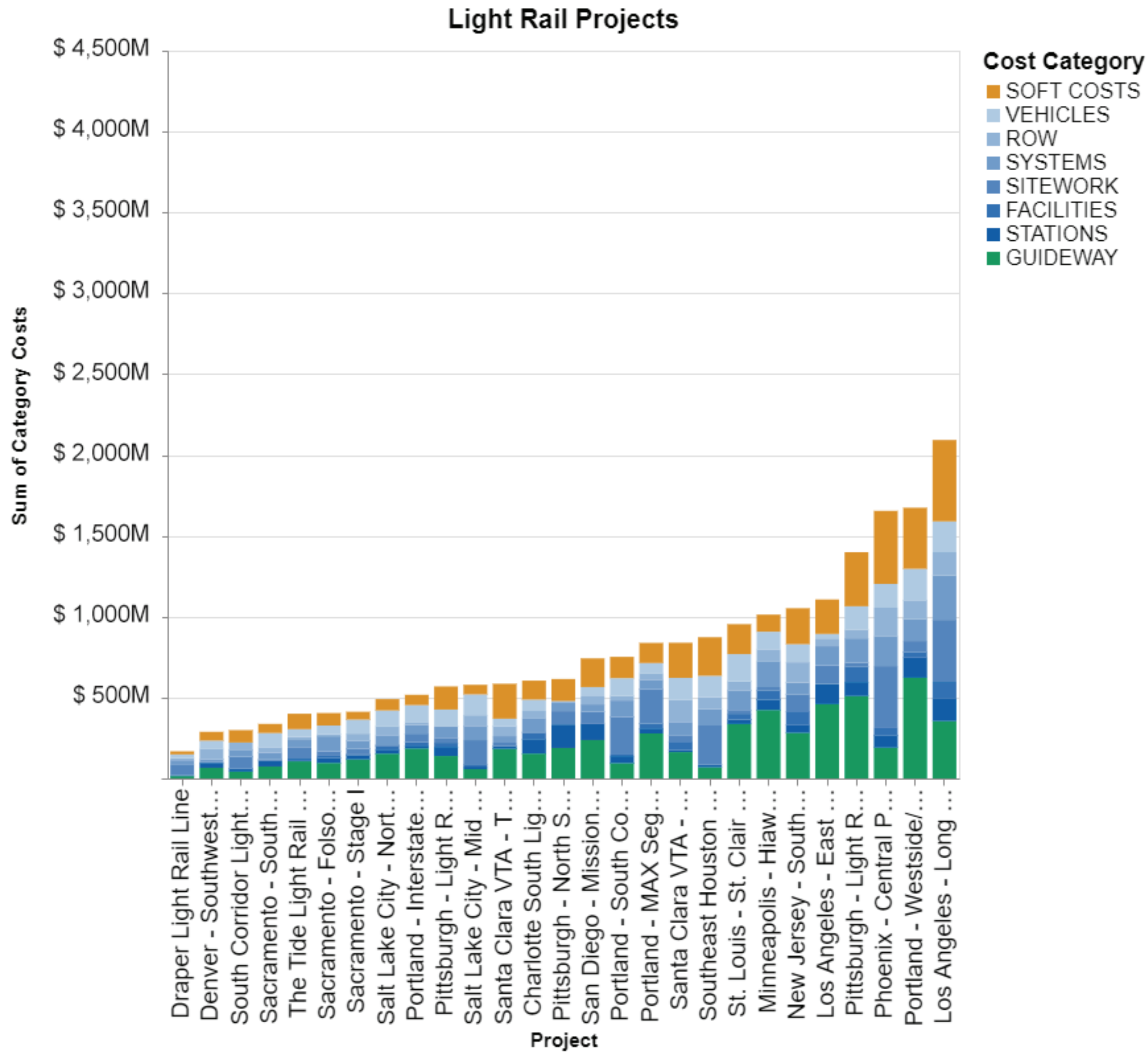
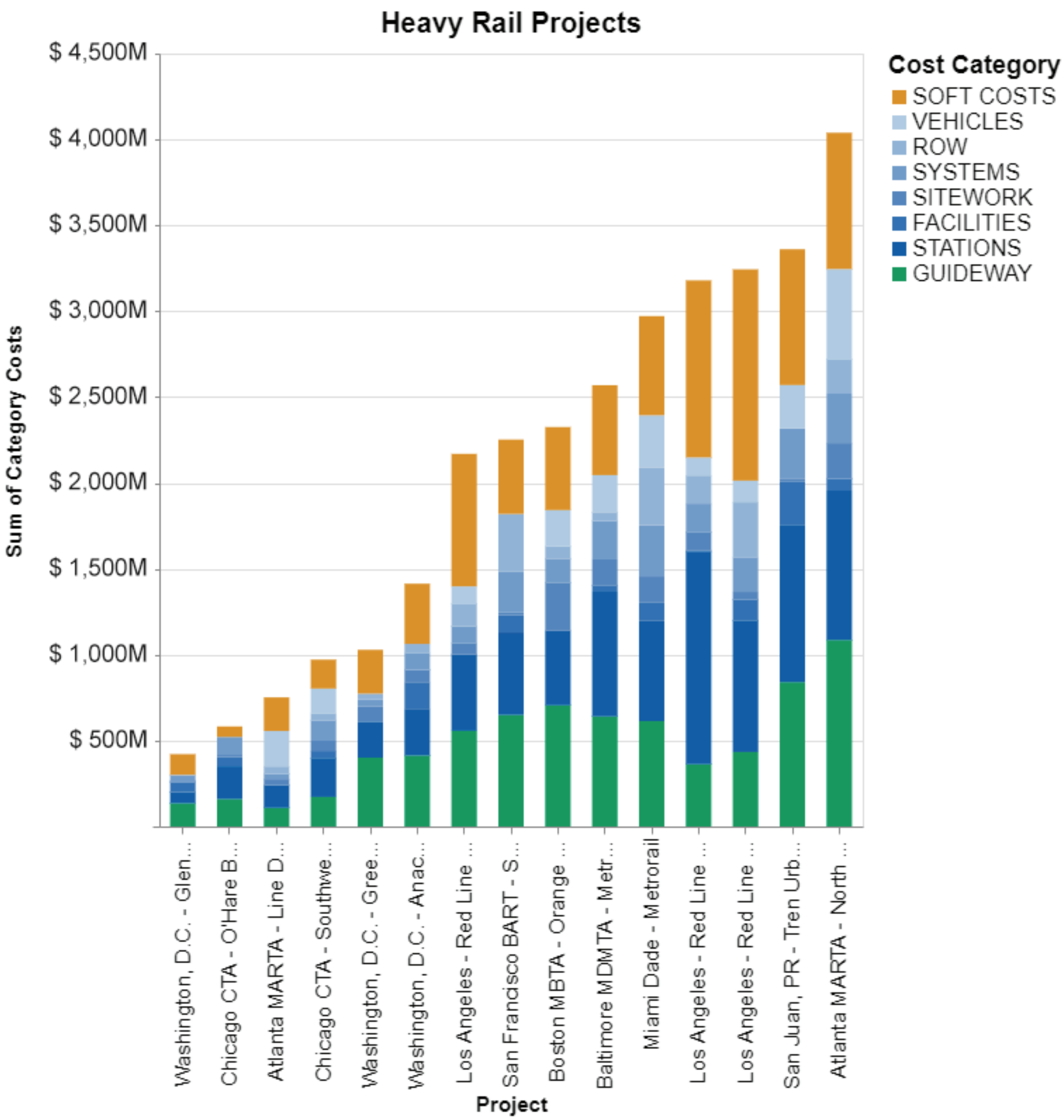


Image 3: Heavy Rail project costs by mode and Standard Cost Categories (in 2021 inflation-adjusted dollars)



Recommendations

Based on the project team's overall analysis, the two most important recommendations relate to data quality and user interface. First, databases are only as useful as the quality of the underlying data. To ensure that the database remains useful, the project team believes that greater efforts should be taken by grantees to improve reporting for both accuracy and completeness, and that the FTA should work with grantees to validate data and gain insight into how grantees categorize their own costs. A good first step is to work with grantees with multiple projects in the database because these agencies, presumably, are most familiar with how to reconcile the Standard Cost Categories with their own accounting practices. Second, the project team also found the Microsoft Access Database contains valuable project details that do not get exported out of Access with the data. The Project Descriptions, for instance, provide important context, as do the data included in the Project Reports. In addition to these overarching recommendations, the project team identified the following ways the FTA and grantees can improve the Database's quality and usability.

1. FTA should consider adding additional specificity and/or seek clarity from grantees about categories where grantees routinely select "other" or "unspecified," such as indicating "unspecified" for type of bus.
2. Grantees itemize their costs differently in internal project accounting from FTA Standard Cost Categories. FTA should investigate why this is and develop checks to ensure grantee data integrity. Bringing greater attention to good data management practice and its importance is critical to the Database's utility. (As previously, noted, the FTA does not requires the use of its standard cost categories in all of its other programs).
3. Currently more information is available to users with access to Microsoft Access than those who use the CSV file. The FTA should work towards revising the database so that the spreadsheet version contains all the information the database version does. (Note that the Access version currently has its own limitation because it is difficult to export all of its data, in bulk.)
4. Grantees should demonstrate an ability to report cost data consistently across capital projects.
5. Additional research could be conducted with grantees who have completed multiple capital projects to examine project cost histories, changes over time, and experience with Standard Cost Categories.
6. Grantees should report unit costs for professional services in hourly rates and total hours rather than solely as a percentage of hard costs.
7. Grantees, policymakers, and the FTA can use the database, where it provides actionable insights, to identify policy implications and advance shared goals. For example, the database can provide helpful data on the high cost of providing

parking and automobile access at transit stations, locations where land uses may be better suited for other purposes.

8. The FTA should consider how it could update the Database more frequently; projects could be added even before final costs have been determined. For example, information about the first phase of the Second Avenue Subway which opened on January 1, 2017 has not yet been added to the database because all of the costs have not been finalized.
9. The Database could include pre-construction cost estimates so that comparisons can be made between estimated and final costs.
10. Additional research should be conducted and guidance given to grantees about how to categorize soft costs so that the Database can provide more relevant information about these cost components.
11. A glossary of terms associated with the Database could help avoid confusion and improve consistency.
12. If the Database had additional information that the FTA already collects, users would be able to better understand costs. For example, if ridership estimates were incorporated into the Database (or hyperlinks provided to such information), users would be able to better understand why transit stations cost much more in one city than another.

Analysis

Inflation-Adjusted Dollars

The project team downloaded the October 2022 version of the Capital Cost Database. The team then adjusted all of the unit costs to 2021 dollars using the Bureau of Labor Statistics Consumer Price Index.

The Database

The database contains 54 projects, spread across five modes:

- Light rail: 27
- Heavy rail: 18
- Commuter rail: 3
- Bus rapid transit (BRT): 5
- Trolley: 1

Some Exclusions

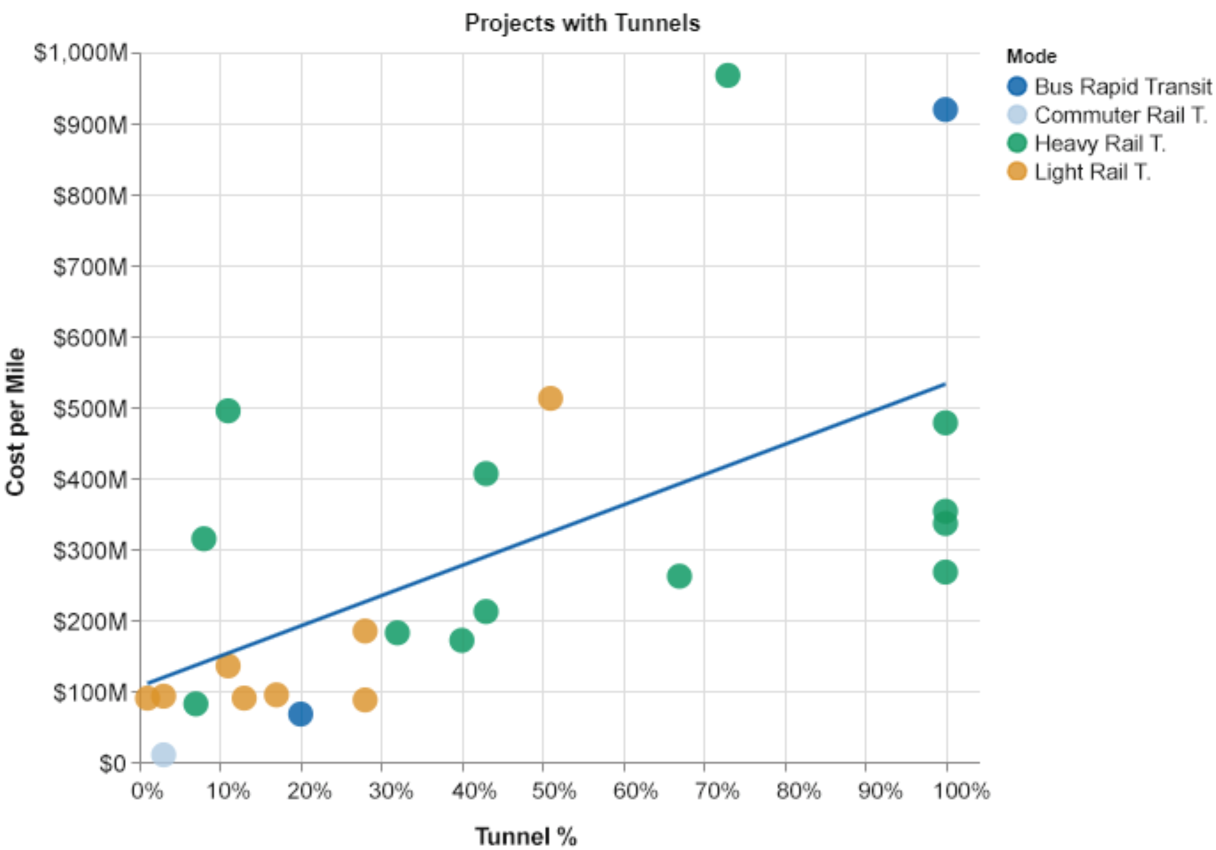
After reviewing the database, the project team excluded five of 54 projects from its initial analysis, as these projects are rehabilitations or outliers (i.e. unlike other projects in their category). The project team did, however, incorporate them into database checks for things like missing data. A summary of the five excluded projects follows:

- **Chicago Ravenswood Brown Line** (highest-cost/mile in the database): This is a rehabilitation project for the entire Brown Line. The length reported for this project is that of a short segment of the line. Furthermore, the project is not comparable with the construction of new heavy rail lines.
- **Minneapolis Northstar Line** (second highest-cost/mile): The Northstar line operates within an existing freight corridor; thus, some of the units and costs cannot be compared easily across projects.
- **Philadelphia Market-Frankford Line (MFL) rehabilitation**: This is the rehabilitation of an existing elevated line, which could be in its own category for cost comparison but should not be compared with the construction of new lines.
- **Chicago Blue Line Douglas Branch**: This is a rehabilitation project, including ADA accessibility at all stations.
- **South Boston Piers BRT**: This is a short tunnel, which accurately reflects the cost of complex urban road tunneling and can go in this database but should not be bundled with at-grade BRT projects.

Light and Heavy Rail

Of the 49 projects included in this analysis, 42 are light or heavy rail. These modes are broadly comparable. The light rail lines in the database are less expensive when they are entirely at-grade, but once significant tunneling or grade-separation is introduced, the costs begin to look more similar to the heavy rail projects (Image 4).

Image 4: Costs per mile increase, regardless of mode, as tunnel percentage increase



How Agencies Use Cost Categories

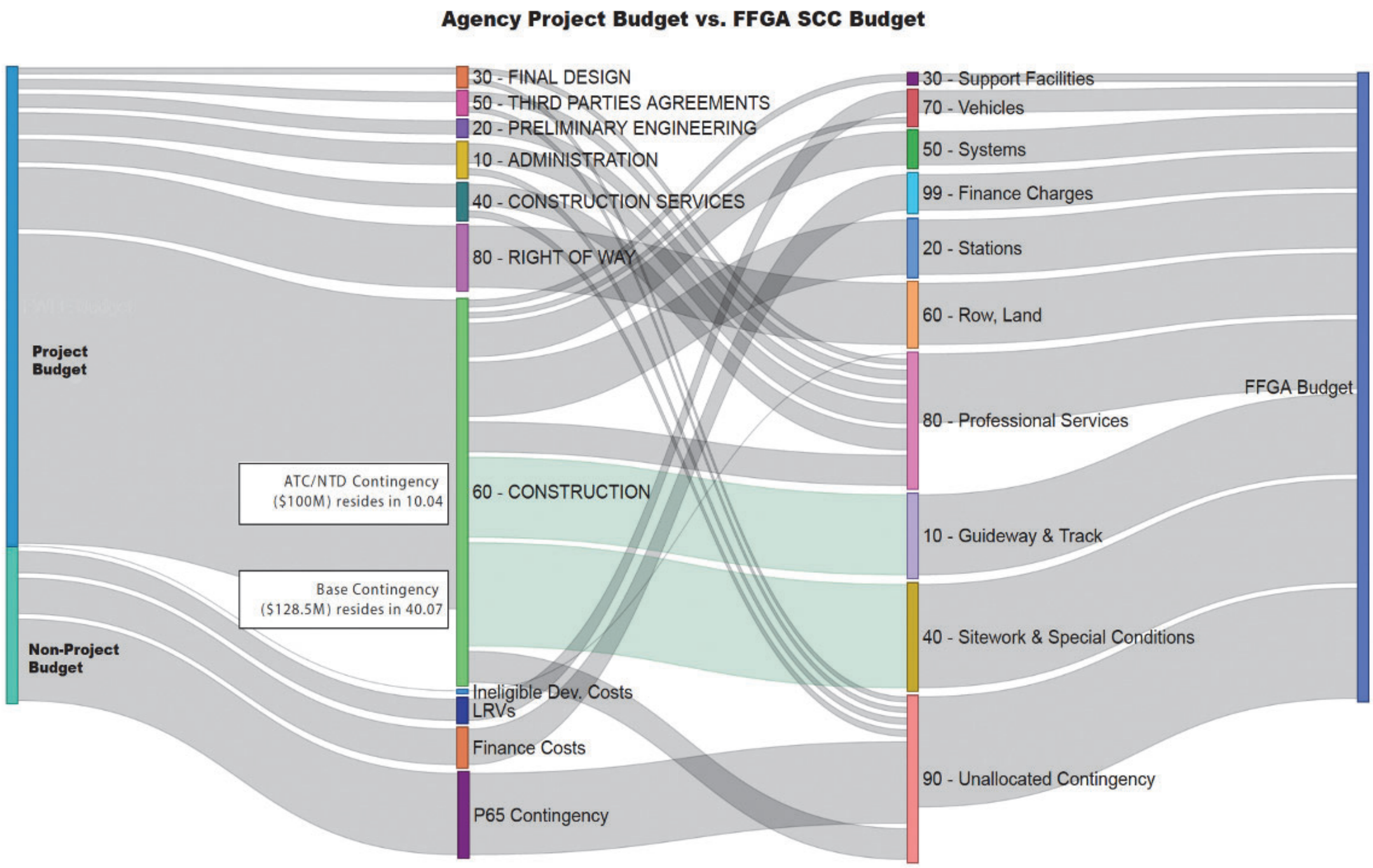
During the project team's interviews with cost estimators and agency staff, it repeatedly heard that the FTA's Standard Cost Categories (SCCs) were useful, but not how most agencies do their internal accounting. One agency, however, indicated that it was standardizing its accounting to match the SCCs. Additionally, the team learned of a separate, but much larger challenge: agencies struggle with consistent accounting within and across projects. This makes it hard for agencies to do their own accounting, but also adds the additional step of reconciling inconsistent data with FTA requirements. These challenges present a clear solution: Work with agencies to build consistent data management practices. (Note that the FTA does not require the use of its standard cost categories in all of its other programs).

For one example, when the team examined utility cost allocation, it observed inconsistencies across the three segments of Los Angeles' Red Line. During segment 1, $41.3 million was spent on urban replacement in-kind public (40.01), private utilities (40.022), and environmental mitigations (40.04). During segment 2A and 2B, only

$863,000 was spent on urban replacement in-kind public utilities; however, another $59.6 million was reported under third-party work (40.082). Without greater insight into how costs were allocated, Database users do not have sufficient information to determine how these costs break down or how they overlap. Finally, when the team looked at segment 3, $0 was allocated to 40.082, the generic third-party category that featured so heavily in segment 2, while $57.3 million was spent on urban replacement in-kind public utilities. This example highlights variation in how one grantee defined SCCs over time, and how that influences the database's integrity.

Second, when grantees reconcile internal accounting with the SCCs, there's opportunity for costs to be misallocated or for grantees to interpret an SCC differently from how it was intended. A transit agency official shared a budget crosswalk (Image 5) showing how her agency redistributes its costs across FTA cost categories. In this graphic, the vertical line on the left shows how the agency has both project and non-project costs. (A transit agency might consider the cost of buses to be outside the scope of a single project, but if federal money is used to acquire those buses via a CIG grant, FTA would consider that cost to be a project cost associated with a specific grant.) The middle vertical line shows the agency's cost categories including (30) Final Design and (50) Third Party Agreements. The agency takes both its project and what it considers non-project costs and then transforms them into the SCCs, as shown on the right in image 5. In tracing how the budget is divvied up from project budget and non-project budget to the transit agency's more detailed accounting to SCCs to FFGA budget, it appears that some ineligible development costs may have been included in the FFGA budget, further underscoring how challenging it can be to reconcile multiple accounting methods.

Image 5: How One Agency Reclassifies Its Costs to Match SCC Categories.



One cost estimator the project team interviewed explained that determining where costs go is sometimes "more of an art than a science." This is a typical refrain in this kind of work. When the project team examined category 40.084, Maintenance of Traffic, only three projects recorded any costs. Based on the team's interviews with transit agencies, the maintenance of traffic is critical to agency projects; thus, it seems likely that these costs were folded into other categories or included in lump sum costs that have not been disaggregated.

Lastly, the project team noticed that categories that should match across categories, such as projects with Aerial Stations (20.02) and projects with Elevators (20.071) and Escalators (20.072), have unexplained discrepancies. After excluding rehabilitations from the analysis, the project team assumes that the remaining 13 projects with an aerial station should have elevators and/or escalators. Only seven of 13 have an elevator, escalator, or unspecified. When the team summed the projects within the database with elevators and escalators, it only found 12 projects with those elements.

Cost Trends Over Time

One clear strength of the database is that it shows how costs have changed over time in different cities. After excluding the five projects mentioned earlier, there were nine cities with multiple projects in the database. Los Angeles stands out from this group because the Red Line's costs per mile, in 2021 inflation-adjusted dollars, declined from segment 1 to segments 2A, 2B, and 3. In fact, segment 1 is the most expensive non-excluded line in the database. This suggests that LA Metro may have adopted more economical ways to build heavy rail over time. The data bears this out. We see station, vehicle, systems, and soft costs decline between segment 1 and segment 3. A closer examination indicates that the unit costs of things like track and substations declined over time, too. Segment 1, not surprisingly, also absorbed startup costs, like the expensive maintenance facility. The project team believes that there are important lessons to be learned by speaking to people at LA Metro and taking a closer look at the Red Line's costs to see how it managed to reduce them over time.

When the project team compared these earlier findings with more recent projects in the NYU Marron and Eno databases, it found that later rail projects have seen costs increase.

In the FTA Capital Cost Database, of the nine cities that completed two or more rail projects in different years, the cost per mile declined only in Los Angeles and Washington D.C. In the other cities, the costs increased. For example:

- In Portland, the first MAX segment cost $43 million per mile, but the extensions in the 1990s and 2000s cost $90 million per mile. The more recent Milwaukie MAX extension was $237 million per mile.
- In Pittsburgh, Light Rail Stage II, completed in 2003, cost $104 million per mile, whereas the Stage I, completed in 1985, cost $90 million per mile and includes a short downtown tunnel comprising 13% of its length.
- In Salt Lake City, the North South Corridor, completed in 1998, cost $33 million per mile whereas the Mid Jordan LRT, completed in 2011, cost $55 million per mile, indicative of an increasing trend albeit much less than in Portland.

Vehicle Costs

The database includes 29 projects with rolling stock costs. Of these, agencies selected 'unspecified' for 25 (or 86%) of them. While some projects include multiple rolling stock purchases, such as the Minneapolis Northstar Commuter Line, it is unclear why light rail projects, like the Draper Light Rail Line or Charlotte South Light Rail Line have not selected the type of light rail vehicle purchased. The database allows for differentiation between non-revenue and revenue vehicles and also distinguishes between light rail, heavy rail, and commuter rail. Without more detail from grantees, however, it is difficult to calculate a meaningful average unit cost when everything is in the unspecified category (Table 1). For the revenue-service vehicles, the project team recommends reporting the rolling stock model, such as the Siemens Avanto S70 used in Charlotte, so that grantees can adequately compare models and costs.

Table 1: Unspecified Rolling Stock by Project

Project	Element Number	Element Name	Units	Total Cost at Midpoint of Construction	Unit Cost
Boston MBTA - South Boston Piers - Busway	70.044	Unspecified	24	$40,216,636	$1,675,693
Charlotte South Light Rail Line	70.013	Unspecified	16	$52,508,020	$3,281,751
Cleveland - Euclid Ave BRT	70.044	Unspecified	20	$17,760,000	$888,000
Denver - Southwest Corridor	70.013	Unspecified	18	$32,700,000	$1,816,667
Draper Light Rail Line	70.013	Unspecified	5	$18,199,230	$3,639,846
Los Angeles - East Side Extension	70.013	Unspecified	10	$22,390,323	$2,239,032
Los Angeles - Long Beach Blue Line	70.013	Unspecified	54	$78,136,129	$1,446,965
Minneapolis - Hiawatha Corridor	70.013	Unspecified	26	$74,711,000	$2,873,500
Minneapolis - Northstar Commuter Line	70.013	Unspecified	2	$6,300,000	$3,150,000
Minneapolis - Northstar Commuter Line	70.035	Unspecified	24	$60,373,637	$2,515,568
New Jersey - Southern NJ Light Rail Transit System	70.013	Unspecified	20	$73,943,650	$3,697,183
Phoenix - Central Phoenix/East Valley	70.013	Unspecified	50	$116,941,301	$2,338,826
Pittsburgh - Light Rail Stage I	70.013	Unspecified	55	$57,399,440	$1,043,626
Pittsburgh - Light Rail Stage II	70.013	Unspecified	28	$68,203,410	$2,435,836
Portland - Interstate MAX	70.013	Unspecified	24	$72,332,000	$3,013,833
Portland - Interstate MAX	70.064	Unspecified	24	$286,000	$11,917
Portland - South Corridor/Portland Mall	70.013	Unspecified	22	$80,700,028	$3,668,183
Portland - Westside/Hillsboro MAX	70.013	Unspecified	36	$112,423,000	$3,122,861
Portland - Wilsonville to Beaverton	70.035	Unspecified	4	$17,493,000	$4,373,250
Sacramento - Folsom Corridor	70.013	Unspecified	14	$35,687,292	$2,549,092
Sacramento - South Corridor	70.013	Unspecified	24	$60,908,467	$2,537,853
Sacramento - Stage I	70.013	Unspecified	36	$34,600,000	$961,111
Salt Lake City - Mid Jordan LRT	70.013	Unspecified	28	$100,943,961	$3,605,141
Salt Lake City - North South Corridor	70.013	Unspecified	23	$59,800,037	$2,600,002
San Diego - Mission Valley East	70.013	Unspecified	11	$36,961,024	$3,360,093
San Diego - Mission Valley East	70.064	Unspecified	11	$2,257,576	$205,234
Santa Clara VTA - North Corridor	70.013	Unspecified	50	$55,611,000	$1,112,220
Southeast Houston Light Rail	70.013	Unspecified	29	$104,711,000	$3,610,724
Southeast Houston Light Rail	70.064	Unspecified	29	$5,455,000	$188,103

Using the Data to Inform Policy

This dataset provides an opportunity for the FTA, grantees, and policymakers to assess the cost implications of small and large policy and design decisions. Nationally, state legislatures, city councils, and mayors are reevaluating existing parking policies and analyzing their impact on affordable housing and urban form. The project team quantified the costs of automobile access and parking to show cost effects (Images 6 and 7). The costs of all automobile infrastructure across 18 different projects range from $1.68 million to $119.4 million, or 0.6% to 22.2% of project hard costs. While some parking may be necessary, it is worth asking if transit projects should bear these costs?

Image 6: Breakdown of Automobile Infrastructure Costs by Total Cost

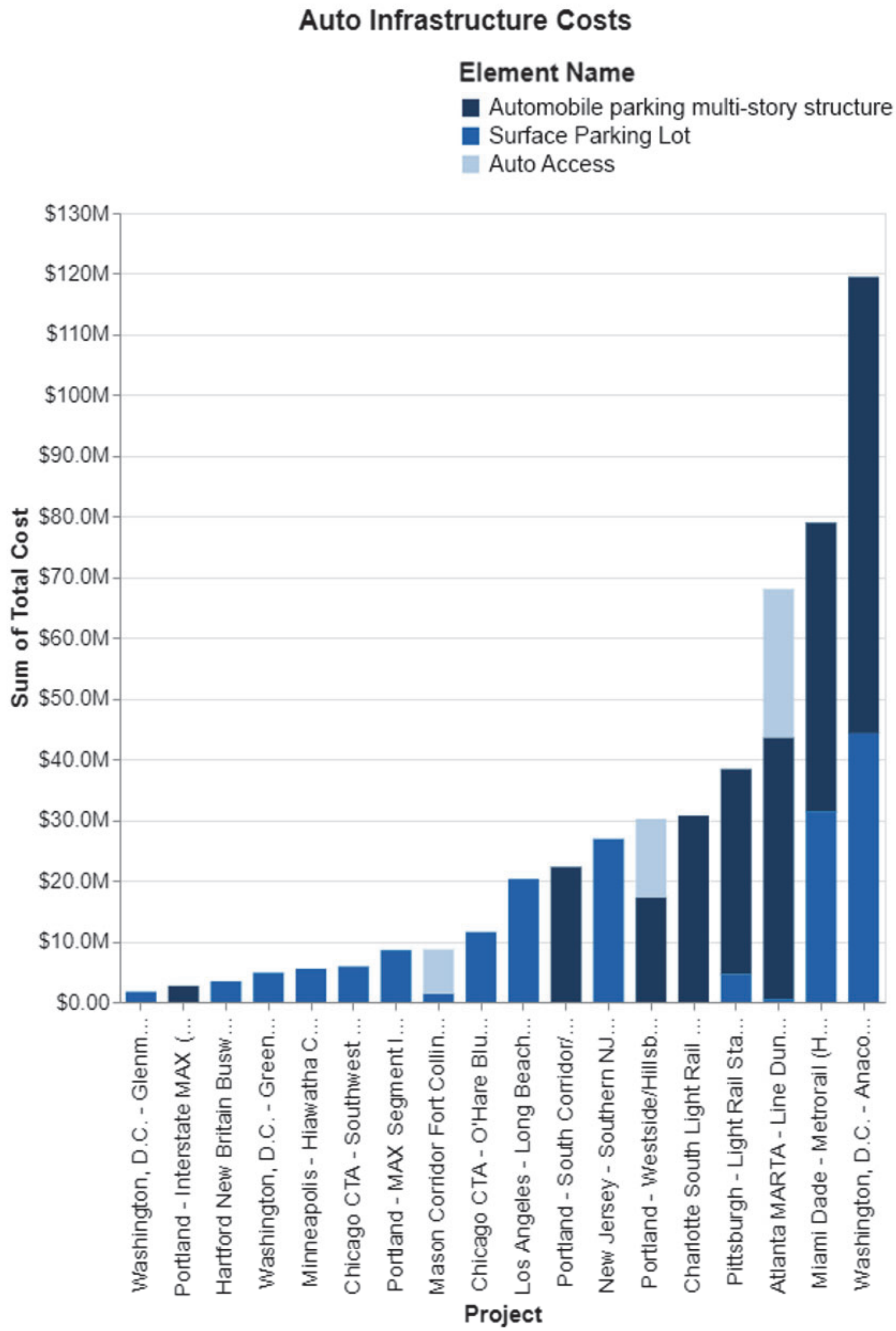
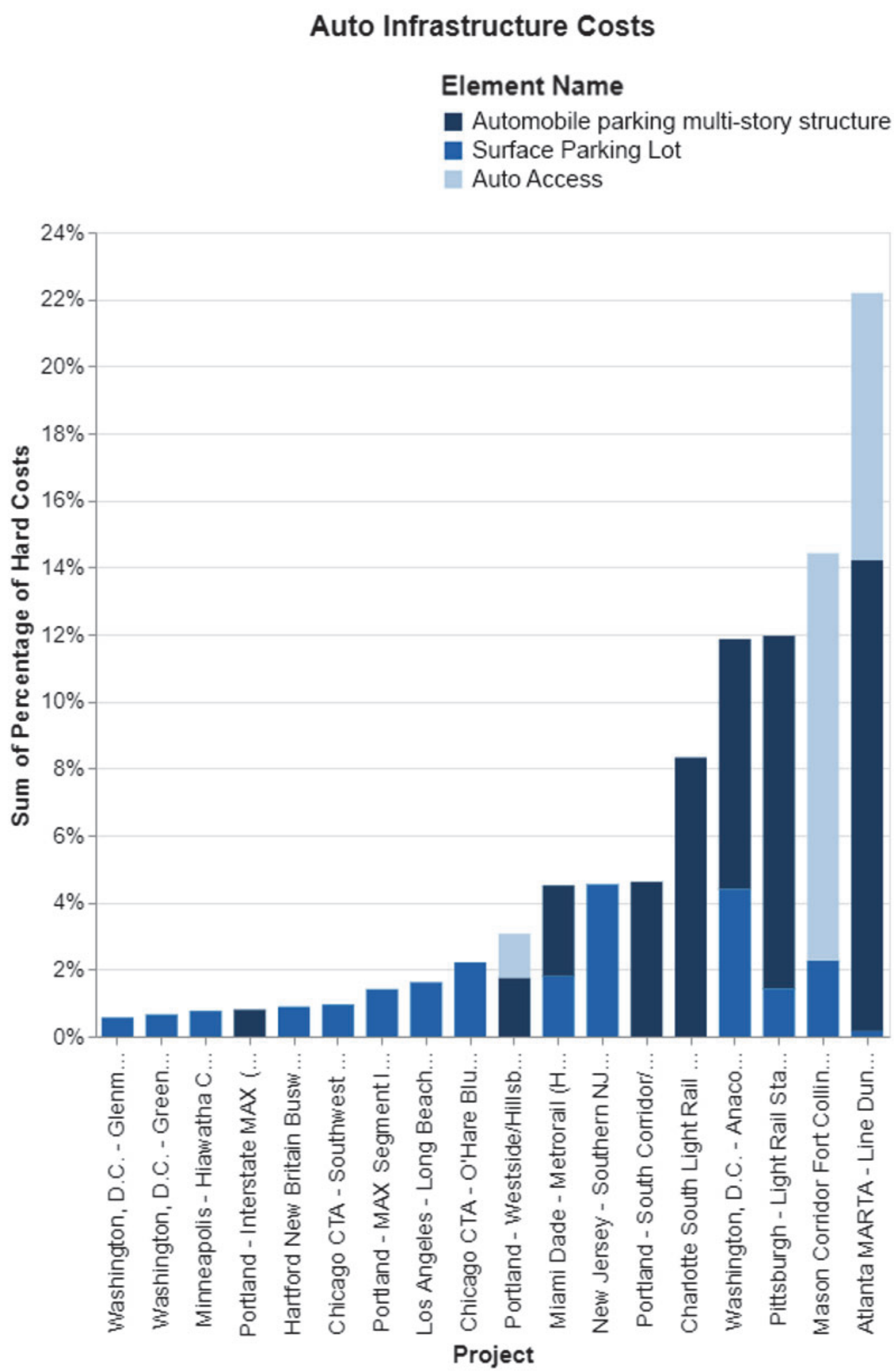


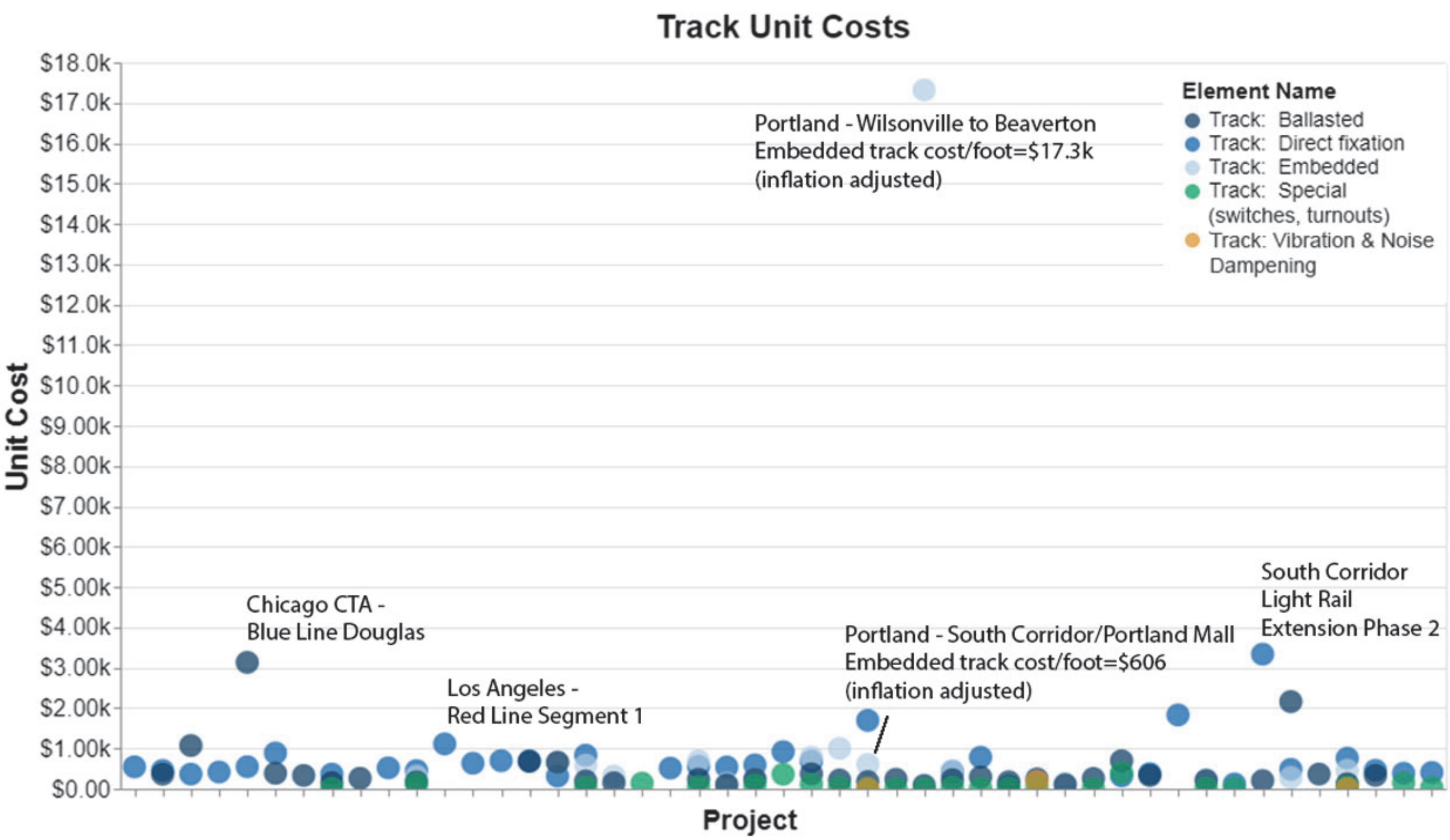
Image 7: Breakdown of Automobile Infrastructure Costs by Percentage of Hard Costs



Variation by Item

Some SCCs show variation beyond the reasons already discussed. The project team believes that the contexts in which specific projects are built is essential to understanding cost variations and the underlying drivers of observed cost differences. One clear example is the variation in embedded track. For instance, Portland's Wilsonville to Beaverton project carried a per linear foot cost of $17,319.36 while the South Corridor/Portland Mall project was $606.05 per linear foot, a 97% difference (Image 8). Similarly, when the project team examined costs in other cities, it found a wide variation across other items.

Image 8: A Closer Look at Embedded Track Costs by Project



Professional Services

Professional Services are often inconsistently reported. First, when the project team examined the data, it noticed that some grantees failed to enter any costs for numerous subcategories. Second, when the project team tried to reconcile the data by multiplying the reported unit cost (always a percentage) by the total hard costs, more often than not, the product did not match the total costs at the midpoint of construction. Sometimes the discrepancy was minor, but after going through each expense associated with the Professional Services category and its subcategories (341 lines in total) the team found that only 114 (33.4%) matched the total reported cost (Table 2; Appendix A). Appendix A includes every subcategory in dataset where the unit cost multiplied by the number of units was 95% or less than the total reported cost.

This is another example of data problems that underscores the need to improve the quality of data reporting.

Table 2: Professional Services; Imperfect Data

Line Items	Line Items	Projects
Non-zero soft costs line items/Projects that have reported soft costs	341	54
Soft costs line items with unit and unit cost information	254	47
Soft costs line items in which the ***unit*** * ***unit cost*** quotient match the reported Total Cost of the line item by 95% or higher	114	-

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