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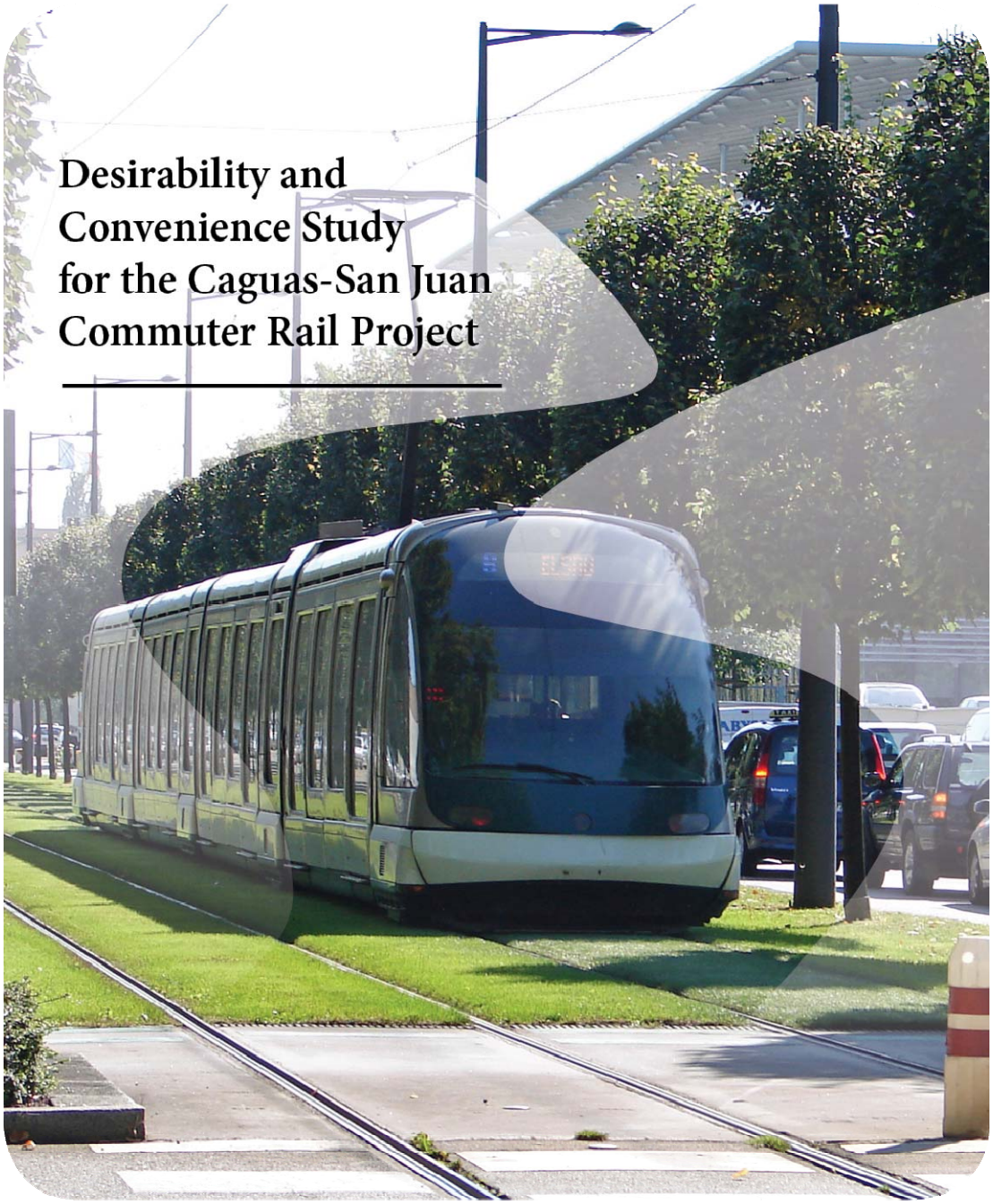
Desirability and Convenience Study for the Caguas-San Juan Commuter Rail Project



CAGUAS
NUESTRO NUEVO PAÍS
CENTRO Y CORAZÓN
DE PUERTO RICO

Departamento de Transportación y Obras Públicas

CARRETERAS

NOVOTREN

General Disclosure

This Desirability and Convenience Study (the "Study") has been prepared pursuant to the requirements of the Puerto Rico Public-Private Partnerships Act (the "Act") PR ST T. 27 § 2606. This Study seeks to determine whether the establishment of the proposed Public-Private Partnership ("P3" or "PPP") for the Caguas-San Juan Commuter Rail Project ("the Project") described herein is advisable.

This Study was formulated according to the Desirability and Convenience Study General Guidelines and will be submitted before the Public-Private Partnerships Authority ("the Authority") and its Board of Directors for evaluation and compliance with the Act. This Study was commissioned by the Department of Transportation and Public Works ("DTPW"), the Puerto Rico Highway and Transportation Authority ("PRHTA") and the Autonomous Municipality of Caguas ("AMC"), with the assistance of its advisor Estudios Técnicos, Inc. ("the Advisor") as part of a financial and technical advisory engagement between AMC and the Advisor.

The Authority appointed KPMG LLP ("KPMG") as its commercial and financial advisor for the Project. In this role, KPMG undertook a review of the Study and the inputs, assumptions and estimates contained therein, and where applicable, provided recommendations to AMC and its Advisor to conduct further analysis of the Project. This Study contains the results of this additional analysis.

This Study is based on estimates, assumptions and market information obtained from sources believed to be reliable. Actual results may vary from those anticipated in this Study. Changes in the transit industry, state and federal laws, market conditions, and shifts in overall economic conditions or other factors may occur, that can alter the assumptions and conclusions presented in the Study. It is recommended that further analysis and due diligence be conducted in subsequent phases of the Project.

The Authority will continue to evaluate and analyze the desirability and convenience of the Project as a P3 as new information becomes available. In particular, the Authority is in the process of procuring a technical advisor who will update cost estimates related to construction and operations. The Authority will advise the P3 Committee of any material changes.

Neither AMC nor the Advisor makes any representation or warranty whatsoever, including representations or warranties as to the accuracy or completeness of the information herein contained, including estimates, forecasts, or extrapolations. In addition, the Study includes certain projections and forward-looking statements provided by AMC with respect to the anticipated future performance. Such projections and forward-looking statements reflect various assumptions and are subject to significant business, economic and competitive uncertainties and contingencies, many of which are beyond the control of AMC. Accordingly, there can be no assurance that such projections and forward-looking statements will materialize. The actual results may vary from the anticipated results and such variations may be material. The Authority, AMC and the Advisor expressly disclaim any liability for any representations or warranties, expressed or implied, contained herein or for any omissions from this Study or any related matters.

The Act and the Authority's regulations, as well as all applicable Puerto Rico and federal laws and regulations, will govern the dissemination of this Study.

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EXECUTIVE SUMMARY

The Public-Private Partnerships Authority ("Authority"), in collaboration with the Department of Public Works and Transportation ("DTPW"), Puerto Rico Highways and Transportation Authority ("PRHTA") and the Autonomous Municipality of Caguas ("AMC"), is contemplating the procurement and delivery of the Caguas-San Juan Commuter Train Project (the "Project") through a public-private partnership ("P3" or "PPP").

The Authority is the sole entity responsible for the implementation of PPPs in Puerto Rico. PRHTA is the public corporation responsible for executing innovative infrastructure and transportation plans, programs and projects that effectively facilitate the movement of people and goods while protecting the natural resources of Puerto Rico. AMC is responsible for addressing the needs of its inhabitants and ensuring their well-being.

The Authority is considering establishing a PPP to Design / Build / Finance / Operate / Maintain ("DBFOM") the Caguas-San Juan Commuter Train. The PPP would likely involve a long-term (30 to 35-year) DBFOM concession agreement with a private entity. It is not anticipated that risks related to revenue and ridership will be transferred to a private entity, with compensation to the private entity based on Availability Payments.

The Project is a planned transit alignment that will connect the Central Eastern Region of Puerto Rico with the public transit system of the San Juan Metropolitan Area (Metropolitan Bus Authority and Tren Urbano) through a separated and exclusive right-of-way (ROW) along highways PR-52 (Luis A. Ferré highway) and PR-30.[1] The train's alignment will run primarily from Caguas to San Juan through PR-52. In Caguas, two (2) origin stations will be developed, one (1) each at Las Catalinas and Plaza Centro Shopping Malls. The destination point in San Juan will be either the Tren Urbano's Cupey or Centro Médico Station. The Tren Urbano is a fully-automated rapid transit line that serves the San Juan, Bayamón and Guaynabo municipalities. It is anticipated that the train will operate seven (7) days a week, eighteen (18) hours a day, from 5:00 am to 11:00 pm. Alternate operating hours will be scheduled as required and subject to special events.

AMC is located south of San Juan and with its access to PR-52, PR-1 and PR-30 is considered a gateway between the Central Eastern Region ("CER") and the San Juan Metropolitan Area ("SJMA"). However, the vital routes which help many people who live in the CER get to work in the SJMA suffer significant delays as a result of severe traffic congestion conditions, not just during peak rush-hour periods, but for most of the day. The Commonwealth and AMC are considering the development of a mass transit system, as discussed in this document, to alleviate congestion by providing an alternative mode of transportation, as well as to reduce vehicle emissions, stimulate economic development (job creation) and improve safety.

A P3 which uses a DBFOM-style delivery model is one which significantly helps mitigate risks related to construction cost and time overruns, interface risk, operational performance risks, operations and

[1] ROW is also available along PR-18 and PR-1 as required for alternative San Juan stations.

maintenance cost risk, etc. The private sector partner will use performance based construction and operational requirements that will facilitate a "whole-life" approach to costing the Project and may help to reduce Project costs as compared to traditional methods of delivery.

The Authority, DTPW, PRHTA and AMC have considered various ways to deliver this Project and recommend that it be delivered as a DBFOM P3 with Availability Payments to be procured pursuant to Act No. 29 of the Legislature of Puerto Rico of June 8, 2009 (the "Act"). This document is being submitted before the Authority's Board of Directors as the Study of Desirability and Convenience for the Project in compliance with the P3 Act.

Project Background and Context

Since 2001, AMC has been planning the development of a commuter rail system as a means of public transportation from Caguas and the CER to the SJMA. The main objective of the Project is to improve the region's livability and to help reduce environmental pollution through the reduction of traffic congestion and private automobile dependency.

The mass transit system strategy proposes a group of integrated transportation modes that combine a Caguas-San Juan corridor with regional and local transportation systems, which would be the primary feeders of projected ridership and revenues that would support the Project.

Qualitative Analysis of Delivery Options

A qualitative assessment of a broad range of delivery options was undertaken. As outlined in Chapter 3 of this Study, each was assessed against the goals and objectives of the Authority and AMC. The considered delivery options include:

- Conventional Design / Bid / Build
- Design / Build
- Design / Build / Operate
- Design / Build / Operate / Maintain
- Design / Build / Finance
- Design / Build / Finance / Operate
- Design / Build / Finance / Operate / Maintain

After assessing the various options the Design / Build / Finance / Operate / Maintenance ("DBFOM") option has been identified as the most desirable method for the delivery of the Project. AMC has sought to improve the certainty of final construction Project costs regarding certain contracts by transferring most risks to the contractor. However, additional analysis and due diligence will be required to refine the risk allocation in advance of issuing a Request for Proposals.

Benefit-Cost Analysis

The benefit cost analysis compares the benefits and costs of two scenarios:

- **NO BUILD scenario**: not building the Project, and keeping the highway system as it is; and
- **BUILD scenario**: delivering the Project.

This comparative analysis is carried out by computing, for each scenario, the benefit-cost ("B/C") ratio, which compares the increase in benefits to the Commonwealth, against the increase in costs for each scenario. This scenario provides a preliminary indication of whether the Project is economically feasible.

A B/C ratio greater than one (1) indicates that a proposed project is economically feasible. Preliminary analysis indicates that the Project has a B/C ratio of between 1.65 and 3.0, based on a range of upside and downside cost and revenue scenarios for the Build scenario. On this basis, the Project is economically feasible and provides significant benefits to the Commonwealth.

Project Funding

The current financial situation of DTPW, including PRHTA, hinders continued investment in the improvement, expansion and maintenance of Puerto Rico's infrastructure. Its mandate includes responsibility for the construction and upkeep of toll roads, highways and expressways, as well as the existing Tren Urbano system. It has the authority to collect revenues from various sources, against which bonds may be issued. However, its present financial position and recent financial performance indicates that it may only have the capacity to provide limited funds to support the Project. An operating subsidy contribution of $20 million per year has been proposed for the first ten (10) years of the Project's operating term, however, further financial analysis and technical due diligence may indicate that a higher or lower subsidy amount may be required.

AMC has indicated a willingness to invest in its transit infrastructure and contribute subsidies or funds to the Project. However, AMC's current financial position and financial performance indicate that, acting alone, it would be likely unable to make sufficient financial contributions to support the Project. Although AMC may contribute funds from alternative sources, such as toll revenues,[2] the quantum of these funds is presently unclear.

Based on current analysis, the Project will likely require multiple sources of funding including AMC, the Commonwealth and possibly the federal government.

User Cost Comparison

The sprawl of the SJMA into the CER, automobile dependence, and high electric, fuel and housing costs have had the effect of burdening and limiting the population's access to transport and housing. In addition, the lack of public transportation alternatives for CER residents limits access to education, health,

[2] Note that PRHTA collects toll revenues, and that AMC does not have the authority to collect tolls directly. An arrangement would need to be made between AMC and PRHTA for the collection of toll revenues, and the application of these toll revenues to the Project.

recreational and work activities offered in the most important centers of economic activity, including SJMA.

The Project would make transportation more affordable to residents of the CER, as presently most residents depend on a vehicle to travel between Caguas and San Juan. According to Estudios Técnicos database, the total cost of a 20-km (12 mile) trip between Caguas and San Juan is $9.76 each way, taking into account the cost of ownership and variable costs of each trip. The perceived cost, however, is $5.60, which only accounts for some variable costs components, such as gas and tolls. In order to achieve reasonable ridership, the Project fare is proposed to be between $2.50 and $3.00 per trip. This fare would significantly reduce the true cost of a typical commute between Caguas and San Juan. With a $2.50 fare, the cost of a Caguas-San Juan trip is reduced by $7.26 (76%) and by $3.10 (60%) in contrast to perceived costs.

Economic Impacts

The Project would generate economic impacts derived from the initial investment in construction, and subsequently from recurring operating costs. These activities will also generate commercial and economic opportunities for local firms.

For the purpose of this analysis, economic impacts have been analyzed on the assumptions that:

- The initial investment in the Project would be in the range of $400 to $500 million (including $25 million in land acquisition), based on work completed by AMC to date; and
- The annual operating expenses of the Project are $12.8 million per year.

Construction activities would generate approximately 3,600 full-time jobs over a period of three years, most of which would be direct jobs and translate into approximately $130 million in personal income. The public sector could earn $28 million in revenues, of which $10 million may revert to the municipal government and $18 million may revert to the Commonwealth.

Financial Feasibility

The assumptions included in this Study for the financial feasibility are based on analysis prepared by Estudios Técnicos, Inc. This assessment is subject to change in subsequent stages of the Project, and the Authority is presently in the process of selecting technical advisors who may provide new cost data related to construction, operations, maintenance, life-cycle replacement and other costs. Additionally, underlying business and financial assumptions regarding fares, revenue, ridership and financial structure may also change as the understanding of demand for the Project evolves. The Authority will work closely with the P3 Committee to analyze changes and the impact to financial feasibility.

Over the term of the operating period, the subsidy to be provided by AMC and/or the Commonwealth (in addition to the $20 million per year for the first 10 years) ranges from a low of $11 million to a high $39 million in the base case (per the assumptions above). The average subsidy is $23 million.

Across all sensitivity scenarios the lowest subsidy requirement is approximately $11 million and the largest is $57 million (downside revenue and high capital costs). The average subsidy is $29 million.

As stated, these estimates are subject to change; however, they provide a reasonable planning benchmark.

Conclusion

The key findings of the Study fall into three groups:

- The need for investment in commuter rail transportation in the PR-52 corridor;
- The delivery model to facilitate the investment; and
- Preliminary benefit-cost analysis and financial feasibility.

Need for Investment: The vital routes which connect the north and south shores of Puerto Rico and also help many people who live in the CER get to work in the SJMA, suffer significant delays as a result of severe traffic congestion conditions, not just during peak rush-hour periods, but for most of the day. There are more than 160,000 daily trips being made in the PR-52 transportation corridor, which is beyond its design capacity and the resulting congestion making journey time between 45 and 55 minutes for a 15 mile journey. This Project will help not only relieve existing and future congestion, but also help to reduce vehicle emissions, stimulate economic development (job creation) and improve safety.

Choice of delivery model: The conclusion of the qualitative delivery model analysis is that a Design / Build / Finance / Operate / Maintain (DBFOM) delivery model is the most suitable option for the Project. While the use of the DBFOM model would facilitate the transfer of several of the key risk groups in the Project to improve outturn cost and schedule certainty, it is not anticipated that risks related to ridership and revenue from the Project will be able to be transferred. There is strong market precedence for this model which will help the Commonwealth transfer significant risk to the private sector and significantly reduce interface risk between phases as one entity will be held accountable for the development and delivery of the Project.

Preliminary benefit-cost analysis and financial feasibility: The benefit-cost analysis described in Chapter 4 shows that the anticipated quantifiable benefits from the Project exceed their anticipated costs regardless of the high/low cost scenarios presented. Congestion relief, travel time savings, job creation and reduced vehicle emissions are key benefits assessed. It is important to note this analysis does not include all of the potential benefits that the Project investments will contribute to the regional economy, for example through improved land values. So, indeed, the benefits are even greater. The benefit-cost ratios were tested for a range of capital expenditure and ridership scenarios. All scenarios demonstrated strong benefit-cost ratios that exceeded the threshold ratio of one.

A preliminary financial feasibility analysis was performed based on a range of capital cost, operating and maintenance costs and ridership scenarios to aid decision making and planning for the Project. Additionally, a downside revenue scenario was also developed to understand the impact of Project revenue if ridership is significantly below expectations. Based on the output of all sensitivity scenarios, the lowest net subsidy requirement in any year of operations ranges from approximately $11 million to $57 million. While these estimates are subject to change, they provide a reasonable planning benchmark for establishing levels of funding.

Based on the findings noted above, the Authority considers the Project ready to move to the procurement phase.

1 INTRODUCTION

1.1 Introduction

In recent years, Puerto Rico has experienced significant urban sprawl and limited densification as a result of extensive highway construction, poor controls over land use development and, in some areas, a buoyant real estate market. This process of urban sprawl has been accompanied by a continued deterioration of public transit services and increased availability of private automobiles, resulting in significant highway congestion, traffic delays and vehicle emissions.

The 2030 Long Range Transportation Plan recognizes these issues and the importance of effective mass transit in the development of livable communities, noting that: '*the increasingly popular concept of "livable communities" requires that pedestrian needs be addressed and protected, and transit opportunities developed to ensure that people have the opportunity of going about their daily lives, at local and regional levels, without being forced to use the automobile.*'[3]

The Government of Puerto Rico, its public corporations and municipalities are responsible for efficiently providing essential services at the lowest possible cost for the welfare of Puerto Rico's citizens. These services include public health and safety, education and transportation services. Due to the financial constraints of the Commonwealth and its municipalities, innovative financing mechanisms have often been adopted to help deliver infrastructure projects to its people.

On June 8, 2009, the Legislature of Puerto Rico approved Act No. 29 ("the Act") to promote and allow the establishment of Public-Private Partnerships in Puerto Rico for purposes therein set forth. The P3 Authority ("the Authority") was created as a public corporation with the purpose of implementing the Government's public policy regarding P3s, pursuant to the Act.

The Act requires the Authority to conduct or commission a Study of Desirability and Convenience ("Study") for each potential P3 Project selected by the Authority. Each Study seeks to ensure that a particular project meets the public policy goals and objectives established by the Act, as well as to determine whether the P3 delivery of the project is advisable. The scope of each Study is determined by the Authority based on the particular facts and circumstances of each project under consideration. Each Study will include, as deemed applicable by the Authority, the matters stipulated in Article 7(b) of the Act. The Authority may expand or reduce the scope of the Study to include other matters not specifically listed in Article 7(b) of the Act, or alternatively, it may exclude matters that are deemed not relevant to a particular project, as appropriate. The Act allows for the establishment or formulation of P3 contracts for a series of Priority Projects (as defined in the Act), including but not limited to the design, implementation, operation, and/or maintenance of transportation systems.

[3] DTPW and PRHTA, *San Juan Urbanized Area: 2030 Long Range Transportation Plan*, p1, January 2011, San Juan, Puerto Rico.

The proposed project is known as: "The Caguas-San Juan Commuter Rail Project" (the "Project"). This document will be submitted for evaluation before the Authority's Board of Directors as the Study of Desirability and Convenience for the Project, in compliance with the Act.

According to 2010 U.S. Census data, the San Juan Metropolitan Area ("SJMA") includes nearly one third of Puerto Rico's total population. In general, the decennial data collected by the Census Bureau defines the SJMA as an entity in constant growth. The need to build a mass transit system arises as a result of the severe traffic congestion conditions, which exist – not just during commuting hours, but on a regular basis – on the main roads that connect the Central Eastern Region ("CER") with the SJMA, namely state highways PR-52 (Luis A. Ferré Highway), PR-30 and PR-1.

The Authority seeks to assess the desirability and convenience of delivering the Project as a P3, specifically utilizing a Design / Build / Finance / Operate / Maintain-style delivery method supported by Availability Payments. A modern and fast commuter rail system, which effectively connects Caguas, the CER and the SJMA, has been identified as the modal option that best satisfies the objectives of DTPW/PRHTA's transportation policy as well as the service needs of the CER.

1.2 Project Description

The Project involves the construction of a mass transit rail system that would service the CER and SJMA, by connecting the municipalities of Caguas and San Juan by integrating with the existing Public Transit System of SJMA (Metropolitan Bus Authority and Tren Urbano).

The Project corridor has a length of 24.3 km (15.1 miles) and would be predominantly located in the existing median of state highways PR-52 (Luis A. Ferré Highway) and PR-30, negating the need to acquire significant additional right-of-way (ROW).[4] The Project contemplates the construction of three stations: two in Caguas and one in San Juan. The two (2) origin stations in Caguas are planned with one (1) in the Las Catalinas Shopping Mall Area and one (1) in the Plaza Centro Commercial Center Area. The station terminus in San Juan would be located either at the existing Cupey station or the Centro Médico Station that services the Tren Urbano system. It is anticipated that the Project will operate seven (7) days a week, for 18 hours per day, from 5:00 am to 11:00 pm (commencing one hour before and closing one hour after Tren Urbano). Alternate operating hours would be scheduled as required to accommodate special events or other public policy objectives.

The Project is characterized by six (6) main capital components, namely:

- Rail construction and placement;
- Rollingstock, including locomotives and carriages;
- Three (3) stations;
- One (1) operations and maintenance facility, to be located in Caguas;
- Two (2) secured park-and-ride facilities, intended to provide a combined total of 861 parking spaces; and

[4] ROW is also available along PR-18 and PR-1 as required for alternative San Juan stations.

- Infrastructure improvements to:
  - State highways PR-52, PR-30 and PR-1;
  - Intersections PR-52/PR-30 and PR-52/PR-1; and
  - Caguas Northern Tollbooth.

1.3 Project Objectives

The Project's strategic objectives are to:

- **Establish a mass transit system** that is efficient, safe and reliable;
- **Reduce automobile dependency**, which will help alleviate congestion in the CER and reduce vehicle emissions;
- **Provide an improved and expanded transit service** with increased accessibility and mobility that is superior to existing transit alternatives and improves the region's livability; and
- **Stimulate economic development,** through the construction and operation of the Project as well as reducing transportation costs, which will help improve the quality of life for families in the CER.

1.4 Project Benefits

The expected benefits resulting from implementation of the Project include:

- An environmentally friendly transportation alternative for residents and visitors;
- A user-friendly experience for passengers, pedestrians, residents, tourists and visitors;
- Reduction in greenhouse gas emissions produced by automobiles;
- Reduction in traffic congestion;
- Increased productivity generated from time savings;
- Increased economic activity in adjacent areas;
- Increased business for local firms involved in the Project's design, construction, operations and maintenance; and
- Creation of jobs and socioeconomic benefits for Puerto Rico.

1.5 Project Status

DTPW/PRHTA and AMC previously developed a complete set of plans and specifications, including an Environmental Assessment (valid through September 2018), for the construction of a Bus Rapid Transit ("BRT") and diesel train systems. These plans and specifications will need to be converted to address a commuter rail transit project. These documents were prepared by Behar-Ybarra & Associates and they were completed in March 2011. All Commonwealth government endorsements were obtained but are presently overdue. These documents will be used as a reference for future amendments, and final documents and approvals will likely need to be received prior to commencement of the procurement process for the Project.

Presently, no federal environmental approvals are in place. The Commonwealth has decided to commence the NEPA approval process in order to qualify for various federal funding and financing programs. The

Authority will work closely with the P3 Committee selected for this Project to analyze the merits of securing federal funding and developing an appropriate strategy.

2 PROJECT BACKGROUND AND CONTEXT

2.1 Transport Organized for Orderly and Sustainable Development

In 2001, AMC commenced initial investigations into the development of a commuter rail system that would connect the municipalities of Caguas and San Juan. On March 23, 2007, and following several preliminary studies and designs, a collaborative agreement was signed by DTPW, the Government Development Bank for Puerto Rico ("GDB"), AMC and the Central Eastern Technological Initiative ("INTECO", for its Spanish acronym)[5] for the development of a mass transit system in the CER.

The primary objective of the collaborative agreement is to improve the CER's livability through the reduction of environmental pollution, traffic congestion and automobile dependency. The proposed mass transit system, named *Transport Organized for Orderly and Sustainable Development* ("TODOS", for its Spanish acronym), is a group of integrated transportation modes that combines a Caguas-San Juan rail corridor with local and regional transportation systems.

The CER will have two main transportation transfer centers which will serve as feeders to the Project: Caguas and Humacao. Caguas will be the center of eight inter-municipal routes within the CER, while Humacao will be the center of four inter-municipal routes within its region. The scheme will provide inter-municipal transportation among all CER municipalities. The system will help support present-day ridership while providing enough growth capacity for more than a 75% increase.

Consistent with Federal Regulations, the *2030 Long Range Transportation Plan* seeks to determine the projected transit needs for current and future generations, and provide a strategic approach to the implementation of projects to satisfy these needs.

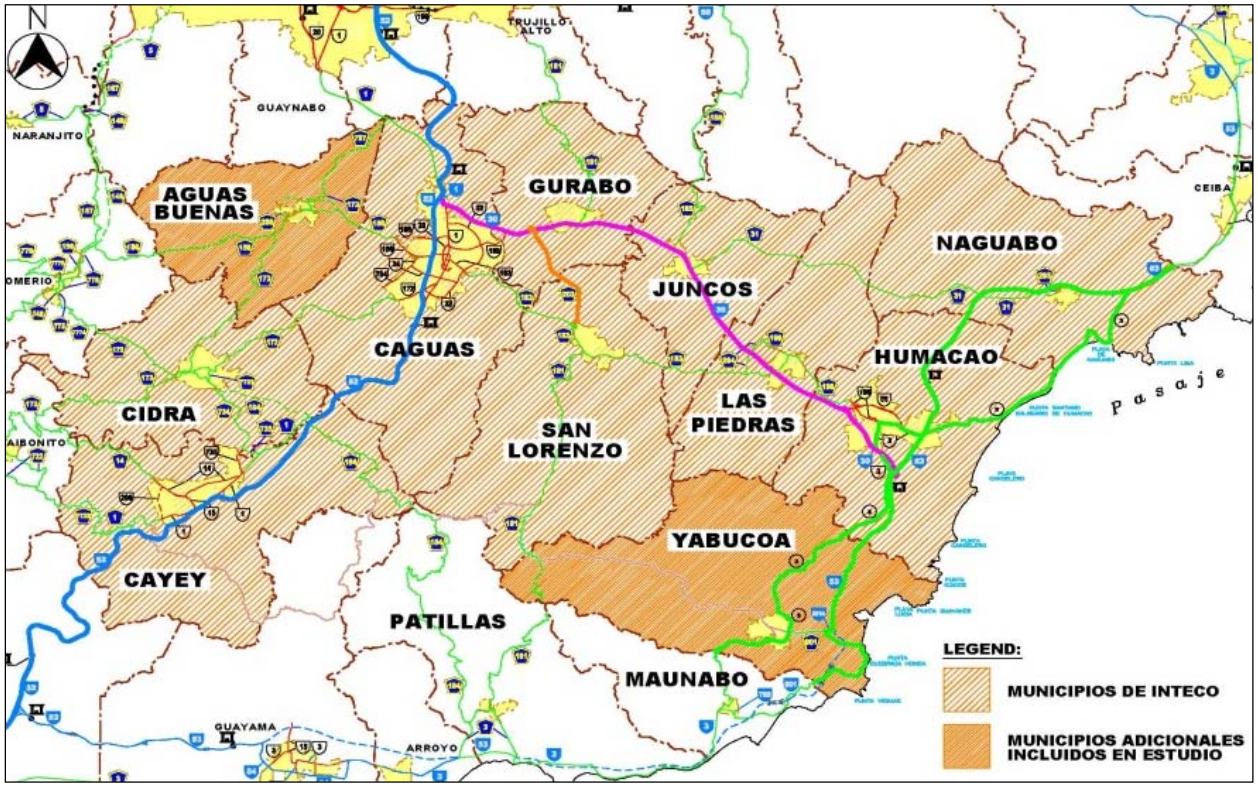
TODOS's purpose is to improve the livability of participating municipalities, help relieve the current motor vehicle user from the chronic level of traffic congestion that presently exists along both state and municipal roads, and lessen environmental pollution through the reduction of traffic congestion. It will also manage to attract those residents who are transportation disadvantaged and who do not presently have adequate transportation alternatives.

2.2 Demographic Overview

The CER is one of Puerto Rico's major economic hubs and is composed of eleven (11) municipalities: Aguas Buenas, Caguas, Cayey, Cidra, Gurabo, Humacao, Juncos, Las Piedras, Naguabo, San Lorenzo and Yabucoa. A map of the region is provided at Figure 2.1 below.

[5] INTECO is a non-profit corporation created with the purpose of achieving economic and social development in the CER's municipalities of Puerto Rico.

Figure 2.1 Map of the Central Eastern Region Municipalities



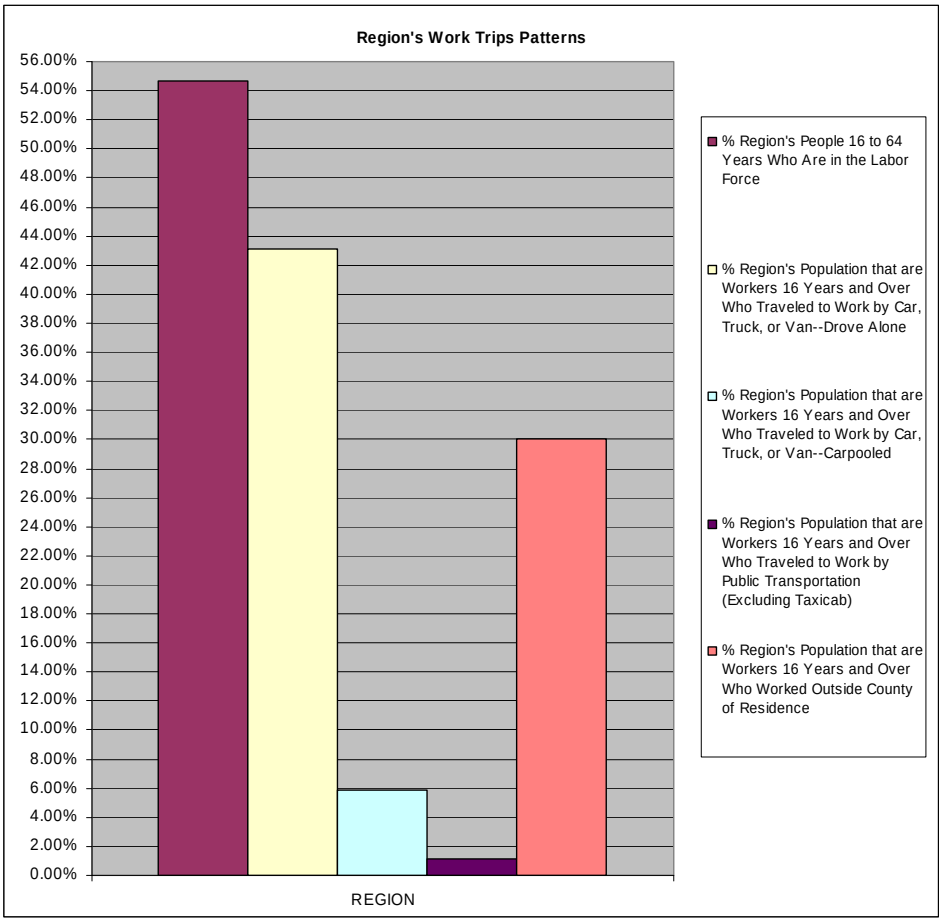
Source: INTECO

As shown below in Table 2.1, the CER has a total population of more than 550,000,[6] which increased by 4.0% during the ten-year period to 2010 despite an overall population decrease of 2.2% for Puerto Rico. When the CER population is combined with the 1.3 million inhabitants of the SJMA, the Project could potentially serve a population of 1.85 million Puerto Ricans, equivalent to 46% of Puerto Rico's total population.

According to the *Census Bureau Community Survey* (2005-2009), 55% of the CER population is aged 16 to 64 years, and represents the labor force (refer to Figure 2.2 below). It should also be noted that 43% of the CER's population consists of workers aged 16 to 64 years who travel to work alone by private vehicle. Of these workers, 30% work outside their municipality of residence.

[6] *U.S. Census Bureau* (2010).

Figure 2.2 Trip Patterns Survey



Source: First Regional Transit System Central Eastern Region by CMA

Table 2.1 Central Eastern Region Population Change, per U.S. Census 2000 and 2010

Municipality	Population (2010)	Population (2000)	Change (%)	Proportion of CER (2010)
Aguas Buenas	28,659	29,032	-1.3%	5.2%
Caguas	142,893	140,502	1.7%	25.9%
Cayey	48,119	47,370	1.6%	8.7%
Cidra	43,480	42,753	1.7%	7.9%
Gurabo	45,369	36,743	23.5%	8.2%
Humacao	58,466	59,035	-1.0%	10.6%
Juncos	40,290	36,452	10.5%	7.3%
Las Piedras	38,675	34,485	12.2%	7.0%
Naguabo	26,720	23,753	12.5%	4.8%
San Lorenzo	41,058	40,997	0.2%	7.4%
Yabucoa	37,941	39,246	-3.3%	6.9%
Total	**551,670**	**530,368**	**4.0%**	**100.0%**

Source: First Regional Transit System Central Eastern Region, by CMA

The largest urban concentrations of the CER are located in the municipalities of Caguas, Cayey and Humacao. Additionally, during the ten years ended 2010, the number of housing units in the CER increased by 22.5%, with the greatest increases in Gurabo (41%), Naguabo (35.5%) and Las Piedras (31%).

Over the past decade, the concentration of government agencies and other work centers in the SJMA has stimulated broad growth and for the whole Area. A corollary of these activities is increased development pressure in Caguas and San Juan, where a significant increase in development of commercial, industrial and residential projects has been observed in proximity to state highways PR-52, PR-30 and PR-1.

It should also be noted that any Project activity must not impede upon any of the environmentally sensitive forests located within the CER, namely: El Yunque National Forest, Carite State Forest and Humacao Natural Reserve.

2.3 Current Transportation Options in the Region

Despite its growing population, no public mass transit system presently services the corridor between the municipalities of Caguas and San Juan. Existing transit alternatives to private travel include privately owned and operated taxis, vans and buses, collectively known as "públicos". These vehicles are regulated by the DTPW/PRHTA and generally serve retirees, disabled and low-income individuals.

Públicos typically operate along state and municipal roads and can accordingly make multiple stops per route. State highways PR-52 and PR-30 are controlled access roads and do not accommodate this type of traveling pattern. Any private or public transit system that utilizes state and municipal roads would not avoid the prevailing levels of traffic congestion, thus making a rail transit alternative attractive. A rail transit alternative additionally has the potential to alleviate traffic congestion in the road network.

2.4 Passenger Demand for the Project

The SJMA is one of the major activity nodes in Puerto Rico. Commuter trips from the CER to SJMA number more than 102,600 trips per day, or 60% of the total daily trips in the CER. Generally, 80% of commuters use private vehicles for their daily trips.[7]

Traffic surveys conducted in previous years indicate that approximately 160,000 private vehicles use state highways PR-1, PR-30 and PR 52 to make their daily commute. These surveys also indicate that, on average, 1.6 passengers occupy each private vehicle, suggesting that approximately 256,000 individuals currently commute along the proposed Project corridor. Conservative capture rates ranging from of 2% to 8% of this commuter base would suggest that the Project would attract between 5,000 and 21,000 riders per day. This compares well to the number of weekday riders currently using Tren Urbano, of approximately 49,000.

In the municipality of San Juan, various activity centers along the PR-52 and PR-30 corridors would benefit from the Project, including:

- Puerto Rico Medical Center;
- The Knowledge Corridor;
- University of Puerto Rico, Botanical Gardens;
- University of Puerto Rico, Rio Piedras Campus;
- Metropolitan University;
- Inter-American University; and
- Areas presently served by Tren Urbano stations.

In the municipality of Caguas, parties likely to benefit from the Project include:

- Commuters using the PR-30 Corridor;
- Commuters using the PR-52 Corridor;
- Las Catalinas Shopping Mall; and

[7] First Regional Transit System Central Eastern Region, by CMA.

- Plaza Centro Shopping Mall.

2.5 Analysis of Service Needs

Table 2.3 below summarizes and prioritizes the key service needs that must be satisfied, as well as the limitations to be overcome, in order to meet the Project's objectives. This Study seeks to address these objectives.

Table 2.2 AMC and DTPW/PRHTA Service Needs

Entity	General service Needs	Limitations	Objectives
DTPW and PRHTA	• Increased capital expenditures to improve mass transit quality and services	• Lack of borrowing capacity and liquidity to finance expansion of existing systems (Tren Urbano)	• Debt reduction
DTPW and PRHTA	• Increase in revenue and subsidy reduction	• Existing low fares	• Develop a sustainable system
AMC, DTPW and PRHTA	• Increase intra and inter-municipal connectivity and mobility	• Restricted economic capacity and liquidity to fund mass transportation projects	• Develop mass transportation projects through private investment
AMC, DTPW and PRHTA	• Stimulate trade and industry growth in the CER	• Inability to attract new industry investments	• Job creation through capital spending and investments in mass transportation systems
AMC, DTPW and PRHTA	• Improvement of environmental conditions	• Lack of effective mass transit for the region	• Emissions reductions by improving transit

Source: Caguas-San Juan Commuter Rail Office

2.6 Project Scope of Work

The Project includes the design, construction, operations and maintenance of a commuter rail corridor between the municipalities of Caguas and San Juan. These activities will be undertaken in two primary phases: Design-&-Build ("D&B") and Operations & Maintenance ("O&M"), as discussed below.

2.6.1 Design-&-Build

The Design-Build phase, or construction phase, of the Project includes activities such as design, construction, installation, integration, procurement, testing, and/or certifying components such as:

- Roadways and structures;
- Rollingstock, including locomotives and carriages;

- Station stops and station stop equipment;
- Secured park and ride facilities;
- Interfaces to wayside equipment for LRV vehicles;
- Track-work and special track-work (ballast, embedded, direct fixation or others);
- Automatic train protection systems;
- Intelligent transportation systems ("ITS") components and subsystems;
- Communication systems;
- SCADA system;
- Traction power substations and overhead contact system ("OCS");
- Distribution systems;
- Provisions for the fare collection system; and
- Operations, maintenance and storage facilities ("OMSF").

2.6.2 Operations & Maintenance

The Operations & Maintenance phase of the Project includes activities associated with the routine operation and maintenance of items such as:

- Tracks and track-ways;
- Ballasted and embedded special track-work;
- Station stops;
- Rail vehicles;
- Parking facilities;
- Crossing barriers and fences;
- Security and enforcement at stations;
- Support vehicles;
- Wayside equipment;
- OMSF and traction power substation buildings;
- Automatic train protection systems;
- ITS components and systems;
- Communication and security systems;
- OCS system; and
- Fixed and mobile rail borne workshop equipment and rubber-tire work vehicles.

The Authority envisions that participating private sector entities will consist of teams (consortia, joint ventures, or partnerships) of local, U.S. and/or international firms who will jointly be responsible for delivering all of the requirements of the Project pursuant to a Project Agreement. The active participation of local suppliers, contractors, designers, engineers, advisors and investors will be encouraged to promote local economic activity, transfer of technical knowledge and develop local expertise.

3 DELIVERY OPTIONS ANALYSIS

3.1 Introduction

On June 8, 2009, the Government of Puerto Rico passed legislation to promote the establishment of Public Private Partnerships (P3s) for the creation of priority projects and, among other things, to foster the development, operations and maintenance of infrastructure facilities. The benefits of P3s may include allocating risks of a given project between the public and private sector to the party who is best able to manage them, improving the services and functions of the Government, fostering job creation and promoting the socioeconomic development and competitiveness of the country.

As per the legislation referred to above, the Authority's Board of Directors shall determine whether or not to proceed with the proposed Project as a P3.

3.2 Delivery Options

P3s can take many forms, each of which presents a different risk profile to the public and private sectors. It is important to compare the P3 delivery options to a traditional delivery option for a given project. Below is a list of the traditional and P3 options considered for the Project in the order of increasing risk transfer to the private sector:

1 **Conventional Design / Bid / Build (Conv).** In this option, the public sector retains almost all project risks. It fully designs the project and then solicits bids from private contractors. However, as the public sector designed the project it retains all design risks which can often result in change orders from the private contractor and increased project costs to be covered by the public sector. The public sector also assumes the role in financing, operating and maintaining the project and all of the related risks including cost overruns during all phases of the project.

2 **Design / Build (DB).** This delivery method begins to transfer risks to the private sector. The public sector will often do preliminary design (15-30% of total design work) and then the private sector will be responsible for completing the design and constructing the project using a fixed-price, date certain contract. Not only does this begin to transfer risk, but this method allows for the acceleration of project delivery as a significant portion of the design work is done while the project is under construction. The duration of these contracts matches the construction term (usually 2-4 years).

3 **Design / Build / Operate (DBO).** Building upon the DB model above, this option includes responsibility of the private sector to operate the project. This model begins to introduce "whole-life" cost analysis into the delivery model as the private sector will typically have to price the risk of operations upfront and be responsible for any cost overruns. If the private sector is responsible for operating the project, they will take that into consideration during the design phase so that the combined construction and operation costs are minimized. The duration of these contracts may be quite long, but usually no more than 15 years as tax-exempt debt limitations often prohibit longer private sector participation. The project is owned by the public sector and it retains the risk to finance it and support the capital maintenance of the project.

4 **Design / Build / Operate / Maintain (DBOM).** This model adds private sector maintenance requirements to the model above. This further increases the risk transfer as they typically have to price the cost to maintain the project, including life-cycle capital maintenance costs upfront. The duration of these contracts may be quite long, but usually no more than 15 years as tax-exempt debt limitations often prohibit longer private sector participation. The project is owned by the public sector and it retains the risk to finance it.

5 **Design / Build / Finance (DBF).** In this scenario, the private sector does not have operations or maintenance risk. It is responsible for getting the project built using a fixed-price, date certain contract and for financing it. In this case, projects are typically 100% debt financed and the total contract terms may vary from 2-4 years (with take-out financing done at completion) to 15 to 30 years. The project is owned by the public sector and it retains the risk to operate and maintain it.

6 **Design / Build / Finance / Operate (DBFO).** This model adds private sector financing to the model above. This may be necessary when sources of public financing are not available. The public entity remains responsible for project maintenance. As private sector finance is used, tax-exempt bond limitations on private operations do not apply resulting in longer contract terms. The project is owned by the public sector and it retains the risk to maintain it.

7 **Design / Build / Finance / Operate / Maintain (DBFOM).** In this model, a significant amount of risk is transferred to the private sector. This model fully integrates the majority of cost elements of the project and seeks to maximize the benefits of whole-life costing. Contract terms are typically 30-35 years for projects utilizing Availability Payments to compensate the private party and 50+ years for projects which use project revenues (e.g. tolls) to compensate the private party. Project ownership is retained by the public sector.

After analyzing the various options listed above, AMC recommended the Design / Build / Finance / Operate / Maintain (DBFOM) model as the most suitable option for the Project. The Authority has sought to improve the certainty of final construction Project costs on certain contracts by the transfer of most risks to the private sector. This has been effective in improving cost and time certainty, giving the Government the opportunity to improve public services and make progress in the Commonwealth's sustainable development.

3.3 Socioeconomic Impacts

Generally speaking, the Project has several positive socioeconomic impacts for CER, SJMA and Puerto Rico. Investment in the commuter rail and improvements in the regional system transportation will bring the following benefits:

- Improve the quality of life for the region's residents;
- Provide spaces for social interaction;
- Reduction in the traffic congestion experienced daily by users of State Highways PR-1, PR-30 and PR-52 during the morning and afternoon peak hours; and

- Sustain and maintain the economic development, including job creation, that has been experiencing the region, as revealed in the 2010 census.

3.4 Environmental Impact

An Environmental Assessment ("EA") was carried out by AMC to evaluate the actual conditions of land use for the Project's proposed alignment. The action was described as not having a significant environmental impact. Most of the studies revealed that the contemplated conceptual design route runs through areas previously impacted by the construction of existing highways. The implementation of the mitigation measures discussed in the EA will address any minor impact along the Project alignment. The natural systems and environmental context that exists along the studied corridor will not be significantly affected.

3.5 Risk Allocation

Risk Allocation Analysis is used to describe a sequence of analysis and management activities focused on creating a project-specific response to the inherent risks of developing a new capital facility such as the Caguas-San Juan Commuter Rail Project.

The objectives of risk allocation may vary depending on unique project goals, but four fundamental tenets of sound risk allocation should always be observed, namely:

- To allocate risks to the party that is most capable of managing them;
- To align risk mitigation with project goals;
- To share risks when deemed appropriate to accomplish project goals; and
- To allocate risks when addressing customer-oriented performance goals.

The Authority believes the DBFOM model can properly balance the risk allocation for the Project and this model has been used successfully in the U.S. and abroad for transportation projects, including rail.

3.5.1 Risk Sharing

The following risks were analyzed and allocated by AMC:

1 **Environmental Assessments:** Current valid document prepared by DTPW and PRHTA for the construction of a bus rapid transit (BRT) system; very little if any ability to transfer environmental approval risk (including any future amendments) to the private sector.

2 **ROW acquisition**:

- Most of the required ROW is owned by DTPW or PRHTA.
- Additional acquisitions will be necessary. The private sector may be responsible for acquiring the parcels which would be subject to future negotiations or possibly the use of eminent domain by the Commonwealth.

3 **Utility relocation**: The private sector will be responsible for pricing the cost of most utility relocation and performing the work including negotiating with various utilities.

4 **Geotechnical**: Typically, this risk is shared with the private sector, taking risk with certain parameters.

5 **Environmental**: Compliance during construction and operations and maintenance will be the private sector's responsibility, with the exception of unforeseen conditions that are found during construction, the risk of which is typically shared.

6 **Permitting**: EA includes the required endorsement, to be renewed by the private sector. The private sector will also be responsible for securing any local permits.

7 **Community Outreach**: This is often shared by the public sector and the private sector.

8 **Force Majeure**: Events such as acts of war or significant weather events are not insurable and are risks the private sector will likely not be able to take.

9 **Systems Procurement, Integration, and Testing**: This is typically a private sector responsibility through various specialized sub-contractors, such as the rollingstock provider.

10 **Fixed facilities Integration**: This is typically a private sector responsibility through various specialized sub-contractors, such as the signals and systems provider.

11 **Passenger Volume and Revenue**:

- AMC and the Commonwealth will be responsible for promoting the usage and overseeing revenue collection. While the private sector may be responsible for physically collecting fares, they are not intended to take risk related to fare revenue (fare and ridership risk). The revenue is intended to be owned by the public sector including the risks and benefits thereof.
- The private sector will be responsible for commuters' safety and security.

12 **Systems Compliance and Performance**: This is typically a private sector's responsibility through various specialized sub-contractors, such as operators.

13 **Design and Build**:

- Design: The private sector will be responsible for completing the design of the Project and will have the option to utilize some of the design work already done by AMC as part of the EA process.
- Build: The private sector will be responsible for constructing the Project on a fixed-price, date certain basis.

14 **Operations and Maintenance**:

- AMC and the Commonwealth will be responsible for promoting its use.
- The private sector will be responsible for:
  - Construction, operations and maintenance cost overruns;
  - Life-cycle costs;

- Energy costs;
- Equipment and systems replacements; and
- Availability and performance.

15 **Financing**:

- The private sector will be responsible for issuing debt related to the Project, and for providing equity.
- Debt and equity will finance the costs related to:
  - Design and construction;
  - Land acquisition payments;
  - Rollingstock; and
  - Soft costs (e.g. insurance, mobilization, etc.).

16 **Obtaining public sector funding**: AMC will be responsible for promoting its use and obtaining additional funding.

Risks will be apportioned under the Project Contract in a method suitable to projects similar in scope, and using leading practices from other P3 transactions. The ultimate risk allocation may include a distribution similar to that provided in Table 3.5 below.

Table 3.1 Risk Allocation Distribution

Item	Risk	Public sector	Private sector
1	Environmental Assessments	X	
2	Right-Of-Way Acquisition	X	X
3	Utility Relocation		X
4	Geotechnical	X	X
5	Environmental	X	X
6	Permitting		X
7	Community Outreach	X	X
8	Force Majeure	N/A	N/A
9	CTV and Systems Procurement, Integration and Testing		X
10	Fixed facilities Integration		X

Item	Risk	Public sector	Private sector
11	Passenger Volume and Revenue	X	
12	Systems Compliance and Performance		X
13	Construction		X
14	O&M		X
15	Financing		X

Source: Caguas-San Juan Commuter Rail Office

3.6 Contracting Option

In general terms, a P3 is defined as a contractual arrangement between a public agency and a private sector entity to design, build, finance, operate and/or maintain a project. The contract allows the private sector to earn an appropriate risk-adjusted return on their investment and is structured to meet public needs by:

- Optimizing the skills and resources of each party (both public and private); and
- Allocating the risks in the delivery of the service and/or facility to the parties best able to manage them.

Through this agreement, the risks of the public sector are transferred in the form of a service or the development of a facility for the use of the general public.

A P3 can often deliver projects in an accelerated and more efficient manner, and the use of the DBFOM format is strongly suggested. Since it is often a more efficient technique for development, DBFOM will help preserve the Government's scarce financial resources, giving the Government the ability to provide more and better infrastructure service.

There are many examples of P3s used successfully in the U.S. and globally for transportation projects, including rail projects such as the Denver Eagle P3 Project, the Canada Line in Vancouver, and recently the Ottawa Light Rail Project. A summary of some recent North American P3 projects is included below at Table 3.6. The P3 market for rail projects is quite strong and competitive, and participation of the private sector should help to identify the most cost effective solution to DBFOM the Project.

Table 3.2 Recent North American P3 Rail Projects

Project	Key Characteristics and Benefits of P3
Denver FasTracks Eagle P3 Light Rail Project ***Denver, C****olorado* *United States*	• $2.1 billion light rail Project, with 57.6 km (36 miles) of rail, 14 new stations, an O&M facility and 50 cars in married pair configuration • To be delivered as a DBFOM, with fixed and indexed availability payments • Operations expected to commence in 2016 • During the review process, it was estimated that the P3 option gave the Denver Regional Transportation District estimated value for Money savings of more than $300 million
Canada Line ***Vancouver,*** *British Columbia* *Canada*	• $1.8 billion rapid transit line in TransLink's SkyTrain metro network, with 19.2 km (11.9 miles) of track • Delivered as a DBFOM, with availability payments • Operations commenced in 2009 • P3 structure encouraged private sector innovation in Project designs, which has in part contributed to increased ridership
Southeast to West Light Rail Transit ***Edmonton, Alberta*** ***Canada***	• $3.2 billion light rail extension to the Edmonton Light Rail Transit system • Delivered as a DBFOM • Depending on the availability of funding, construction could begin as soon as 2015 • Analysis indicates that a P3 model delivers value for money, offering a total cost that is 3% to 10% less than traditional delivery options, with reduced costs over the project's life and with certain risks transferred to the private sector
Maryland Purple Line *Maryland* *United States*	• $2.2 billion light rail extension, with 25.6 km (16 miles) of rail and 21 stations • To be delivered as a DBFOM with availability payments • Expected that operations will commence in 2020 • MDOT forecasts that value for money will be achieved and efficiencies will be gained by transferring risk to the private partner

4 BENEFIT-COST ANALYSIS

4.1 Introduction

The methodology followed in this benefit cost analysis compares the benefits and costs of not building the commuter rail and leaving the highway system as is (the "no build scenario") with building the proposed rail Project. This comparison is carried out by computing, for each alternative, the benefit cost (B/C) ratio, which compares the incremental benefits of the Project to the incremental costs associated with each build scenario. As the final technological solution for the Project has yet to be selected, a range of construction costs has been used in the build scenario. The extent to which the forecast benefits arising over the analysis horizon from the Project's development exceed the associated costs will help inform the decision on pursuing the Project.

4.2 Description of Alternatives

The alternatives to be analyzed for the Project are described below.

4.2.1 NO BUILD SCENARIO

There is currently no commuter rail from Caguas to San Juan and the travel methods from and to Caguas are through the existing highways (PR-52, PR-30 and PR-1) and local roads. From San Juan to Caguas, the main connector is PR-52, a 7-lane highway with 3 southbound lanes to the AMC Caguas and 3 northbound lanes to the municipality of San Juan, including the downtown area. One lane (lane 7) is interchangeable, depending on the highway's peak hours. Highway PR-52 and State Road PR-1 average 174,300 vehicles each day. The observed travel time during peak periods from Caguas to San Juan varies from 45 to 55 minutes. It has been estimated that if the proposed commuter rail, running parallel to PR-52, is not ever built, the traffic in this highway would continue to worsen in upcoming years. Over the last several years, the CER's municipalities that generate traffic for PR-52 have experienced consistent growth, the no-build scenario assumes that no additional highway capacity is added to the corridor which means that the current highway will only be able to accommodate the estimated future increase in traffic flow with greater congestion and expanded peak periods.

4.2.2 BUILD SCENARIO

AMC and the Authority are considering a range of build scenarios while the details of the schematic design are further refined. For each build scenario the basic configuration of the Project comprises the construction of a commuter railway system alongside and in the median of PR-52. The proposed commuter rail will be approximately 24 km (15 miles) long and will connect the municipality of Caguas with the municipality of San Juan (specifically at the Tren Urbano's Cupey Station or at Centro Médico Station).

Three investment scenarios of the proposed commuter railway system have been developed, specifically:

- **A low capital costs estimate**: $400 million dollars over a three-year construction period;
- **A medium capital costs estimate**: $500 million dollars over a three-year construction period; and
- **A high capital costs estimate**: $700 million dollars over a three-year construction period.

4.3 Benefit-Cost Description

This Study only takes into consideration the monetary value attributable to the benefits associated with the development of the commuter rail from San Juan to Caguas. These benefits can be identified and quantifiable since they can be estimated based on the actual and projected benefits and savings to motorists using the new railway system and the less congested highway, versus the existing congested highways. The study has not quantified any other benefits that could generally be characterized as social benefits. These benefits, which are generally not reflected in market prices, are more difficult to quantify. Benefits and Costs considered will be described for both alternatives, which are: NO BUILD and BUILD scenarios.

4.3.1 Benefits: NO BUILD Scenario

For the purpose of this analysis the benefits in the no build scenario are limited to the cost of not building the commuter rail system. The primary "benefit" of the NO BUILD scenario would be the investment costs avoided by not constructing the Project. Later in the analysis, this benefit is compared to the benefits of building the railway system in order to arrive at a B/C ratio.

4.3.2 Benefits: BUILD Scenario

4.3.2.1 Capacity Expansion and Livability

Currently, the proposed affected highways, roads PR-52 and PR-1, host around 174,300 vehicles per day. This number of vehicles is limited by traffic congestion during peak hours. The road has 7 lanes (3 each way and one reversible), which are not enough during peak hours when the average speed can be reduced to 35 MPH or less. The base case revenue forecast assumes that in year one approximately 10,500 trips a day would use the proposed commuter rail. These trips are assumed to be transferred from the PR-52 highway corridor to the Project, which would alleviate traffic congestion in the corridor and will improve average travel times during peak hours.

4.3.2.2 Reduced Life Costs / State of Good Repair

The existing highway (PR-52) has exceeded its design life and has fallen short of the vehicular traffic needs in the area, especially since it is the main connection from San Juan to Ponce and nearly 15 other municipalities of the region. If the Project is not developed as proposed, the potential results would be a highly congested and failing highway network caused by nearby developing and growing municipalities. The savings from not delivering the Project would be spent on maintaining the existing road, not to mention the subsequent increased costs related to loss of productivity.

At best, the repairs and extension of the PR-52 would only prevent further deterioration and reduce life and obsolescence of a highway network that requires a mass transportation option in order to reduce vehicular flow.

4.3.2.3 Enhanced Operating Efficiencies and Economic Competitiveness

The proposed commuter rail, in addition to adding capacity to the existing highway (PR-52) corridor, would also increase efficiencies by increasing traveling speed (a higher MPH average), improving vehicular flow that in turn would help motorists consume less fuel. The reduction in congestion and trip time would save traveling cost and time for all motorists, making the existing highway (PR-52) more economically competitive and more efficient. Also, the economic benefits of commuters using the train would be higher than commuting by car due to savings in travel time, money and maintenance costs to their vehicles. Later in this study, these economic benefits will be quantified and compared to the cost of implementing the new proposed Project.

4.3.2.4 Environmental Benefits

The environmental benefits of the proposed Project include:

- Reduced fuel consumption, because of more efficient speeds; and
- Reduction of emissions.

4.3.2.5 Safety Benefits

The safety benefits of the Project assumed for the B/CA are the reduction in traffic accidents due to the improved capacity in the corridor.

4.3.3 Costs

Three investment scenarios have been developed for the Project:

- **A low capital costs estimate:** $400 million dollars over a three-year construction period;
- **A medium capital costs estimate:** $500 million dollars over a three-year construction period; and
- **A high capital costs estimate:** $700 million dollars over a three-year construction period.

In addition to the capital cost scenarios noted above, the costs associated with the Commonwealth's support of the Project during the first ten years of the Project was included. In year of expenditure dollars this is assumed to amount to $200 million. Additionally, costs to operate and maintain the Project, including life-cycle replacement costs, are included in the overall Project costs.

4.4 Methodology for Estimating Costs and Benefits

4.4.1 Methodology

To estimate the Benefit/Cost ratio for the proposed commuter rail parallel to PR-52, a version of the California Life-Cycle Benefit/Cost Analysis Model ("Cal-B/C") was used with modifications made to suit the project specific conditions in Puerto Rico. The Cal-B/C model offers a practical method for preparing economic evaluations on prospective of highway improvements and rail developments. The default features of the Cal-B/C model were changed to feature Puerto Rico's trends such as economic factors, value of time, value of fuel, operating costs, taxes, accident rates and accident costs. The modified model measures the four primary categories of benefits that result from highway projects:

- Travel Time Savings;

- Vehicle Operating Cost Savings;
- Safety Benefits (Accident Cost Savings); and
- Emission Reductions.

The inputs to the model were adapted to the reality of Puerto Rico as much as possible, as indicated in the section "Sources of Parameters". The results of the analysis are summarized using several measures:

- Life-cycle costs and benefits;
- Net Present Value;
- Benefit-Cost ratio (benefit/costs);
- Rate of Return on investment (in % return/years); and
- Project payback period (in years).

The results were calculated over a 20-year period, which is the fixed life-cycle forecast for a rail Benefit Cost Analysis (as per the Cal-B/C model). Please note that the commuter rail Project Agreement is expected to have a 30-35 year term, which is not considered the same as the life-cycle period or forecast used in the B/C model (as per the Cal-B/C model) however, we believe this does not materially impact the analysis.

4.4.2 Parameters

Appendix A summarizes the parameters and assumptions underlying the estimates used in the B/C analysis. These include assumptions on transit, fuel costs, Project timing, transit demand, accident rate and cost. General assumptions include the discount rate and economic update factor.

4.4.3 Sources of Parameters

1 **Average Fuel Price:** historic and average fuel prices for regular and diesel gasoline was obtained from Puerto Rico Department of Consumer Affairs (DACO).

2 **Economic Update Factor:** Based on the historical price index of GDP growth for Puerto Rico an economic update factor of 2.5% each year or 1.64 economic index factor (1.025^20) is assumed. GDP and Growth information was acquired from the Economic Report to the Governor 2011 by the Puerto Rico Planning Board. In addition, an average discount rate of 6% was used to calculate the present value. Average Hourly Wage: The average hourly wage for Puerto Rico was obtained from Puerto Rico's Department of Labor, which states an average wage of $10 per hour.

3 **Average Fuel Price:** historic and average fuel prices for regular and diesel gasoline was obtained from Puerto Rico Department of Consumer Affairs (DACO).

4 **Sales and Fuel Taxes:** Tax rates were obtained from the Commonwealth of Puerto Rico Department of Treasury (Hacienda).

5 **Cost of Highway Accidents and Fatalities:** these were based on Motor Vehicle Accident Costs (T7570.2) from the Federal Highway Administration (FHWA), but adjusted to Puerto Rico, by applying the ratio of personal income between Puerto Rico and the United States and by taking into

account Puerto Rico's inflation trends. The adjustment factor considered in cost per injury was of 38.8% since Puerto Rico's personal income per capita is 38.8% below that of the United States.

Table 4.1 Cost per Injury

Severity	Description	US ($ 2012)	PR ($ 2012)
K	Fatal	3,660,497	2,240,436
A	Incapacitating	253,419	155,107
B	Evident	50,684	31,021
C	Possible	26,750	16,372
PDO	Property Damage Only	2,816	1,723

Source: FTA, FHWA, Census 2010

6 **State Highway Accident Rates**: Accident rates were obtained from the historical statistics of DTPW/PRHTA.

7 **Project Data, Project Design, Traffic Data, Traffic Demand (forecast), Highway Accident Data Projections and Project Costs**: were provided by DTPW, PRHTA and AMC.

4.5 Results of the Analysis

Based on the edited Cal-B/C model analysis, and the parameters previously discussed, the B/C results are presented below in Figure 4.1.

Figure 4.1 Investment Analysis

SUMMARY RESULTS

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$44.5	$889.2
Veh. Op. Cost Savings	$42.1	$842.9
Accident Cost Savings	$1.2	$24.7
Emission Cost Savings	$7.2	$143.0
TOTAL BENEFITS	$95.0	$1,899.8
Person-Hours of Time Saved	17,635,457	352,709,142
Additional CO_2 Emissions (tons)	-155,250	-3,105,009
Additional CO_2 Emissions (mil. $)	-$3.7	-$73.9

Source: Refer to the list of sources of parameters – ETI database and estimates

4.5.1 Detail Benefits of BUILD and costs of NO BUILD

4.5.1.1 Travel Time Savings

The benefits in saving time are calculated by using the following approach.

- Using the base and future-year ADT projections we estimate future annual ADTs, without and with the improvement Project, assuming straight-line growth.
- The estimated annual ADTs are then multiplied by the affected length and then divided by the traffic speed to find the total travel time for both scenarios, BUILD and NO BUILD.
- The annual travel time savings (the difference between total travel time with and without building) is then multiplied by the value of time (see parameters) and average vehicle occupancy for each mode to convert travel time savings into dollar values.

Then the dollar values of travel time savings are discounted to estimate their present value. Appendix B recaps the formulas used in the Time Travel Savings calculation.

The results of the travel time benefits are about 353 million hours of time saved over a 20-year period or an average of 17.6 million hours of time saved per year, which results in an average time savings of 4 minutes for each vehicle each day. These travel-time savings would be much higher during peak hours, but for the purpose of this analysis the average peak and non-peak hours is taken into account. Time savings translate into a net present value savings of $889 million dollars over a 20-year period.

4.5.1.2 Vehicle Operating Cost (VOC) Savings

The benefits of implementing a commuter rail (mass transportation) parallel to the PR-52 highway would create savings in vehicle operating costs (fuel use, vehicle wear and tear, etc. due to improved speed) are calculated using the following approach.

- Using the base and future-year ADT projections we multiply the affected segment length to find annual VMT (Vehicle-Miles-Traveled) in scenarios, BUILD and NO BUILD, as well as the difference (VMT savings).
- Then, annual VMT savings are multiplied by the fuel consumption and the unit fuel cost to find the dollar value for fuel VOC savings. Annual VMT savings are multiplied by unit non-fuel VOC to find the dollar value of non-fuel VOC savings. (See parameters).
- Future annual values of VOC savings are discounted to obtain their present value.

Appendix C recaps the formulas used in the Vehicle Operating Cost Benefits calculation.

The present value of the vehicle savings in operating cost benefits are of $843 million over a 20-year period, which average to $42 million in savings each year or about $415 per car, each month.

4.5.1.3 Safety Benefits (Accident Cost Savings)

The benefits of accident cost savings are calculated as follows.

- To calculate the aggregated accident cost (per million miles) multiply the accident rate by the accident cost for each type of accident and add the results. Transit accident cost savings are calculated similarly, except that the aggregated accident cost is calculated by accident event (i.e. fatality, injury, property damage) rather than accident type.
- Annual VMT (in million miles) is multiplied by aggregate accident cost, to result in the annual cost of accidents for both scenarios, BUILD and NO BUILD.
- The difference (BUILD minus NO BUILD, change in accident cost) is discounted to find the present value of future safety benefits.

Appendix D recaps the formulas used in the Accident Reduction Benefits calculation.

The present value of accident reduction benefits is $24.7 million over a 20-year period, which average at $1.2 million in savings each year.

4.5.1.4 Emissions Reductions Savings

The benefits of highway emission reductions are calculated as follows.

- The aggregated emissions cost (per mile) is calculated by multiplying the emissions rate (see parameters) by the emissions cost for each type of emission and adding the results.
- Annual VMT (in miles) is then multiplied by the aggregated emissions cost to result in the annual emissions cost, with or without the Project (Build or No Build).
- The difference in scenarios (BUILD minus NO BUILD, change in emissions cost) is discounted to find the present value of future emissions benefits.

Appendix E recaps the formulas used in the Emissions Reductions Benefits calculation.

The present value of the emission reduction benefits are of $143 million over a 20-year period, which average at about $7.15 million in savings each year or at about $2.45 per day for each person that takes the commuter rail instead of their own car.

4.6 Final Results

Benefit-cost ratios for the range of ridership and capital cost scenarios are summarized in Table 4.2 below.

Table 4.2 Summary of Benefit-Cost Ratios for Ridership and Capital Cost Scenarios

Scenario	Ridership	Investment ($)	B/C Ratio
Base Case with Very High Capital Cost	15,000	700,000	1.79
Base Case with High Capital Cost	15,000	500,000	2.34
Base Case with Low Capital Cost	15,000	400,000	2.77
High Revenue with Very High Capital Cost	22,000	700,000	1.92
High Revenue with High Capital Cost	22,000	500,000	2.51
High Revenue with Low Capital Cost	22,000	400,000	2.97
Low Revenue with Very High Capital Cost	10,500	700,000	1.71
Low Revenue with High Capital Cost	10,500	500,000	2.24
Low Revenue with Low Capital Cost	10,500	400,000	2.64
Downside Revenue with Very High Capital Cost	7,000	700,000	1.65
Downside Revenue with High Capital Cost	7,000	500,000	2.15
Downside with Low Capital Cost	7,000	400,000	2.55

Source: Refer to the list of source of parameters – ETI database and Estimates

Theoretically, a B/C ratio greater than one (1) indicates the proposed project is **economically feasible** since the annual benefits expected to improve the transit system (highway & rail) surpass the costs of developing the Project. Under all analyzed scenarios, the B/C ratio exceeds 1.65 under all cost and revenue scenarios, and on this basis the Project is economically feasible. As previously stated, this analysis includes most, but not all benefits (e.g. improved land values not included), so in theory the ratio may be even higher.

However, it should be emphasized that the range of ratios calculated in this Study are preliminary and are based on early stage, high level cost and benefit assumptions. Further analysis and due diligence of costs and benefits will be required in subsequent stages of this Project.

5 AFFORDABILITY ANALYSIS

For the purposes of this Study, affordability refers to the capacity of the population to purchase basic goods and services. It is applicable to different situations, especially to the capacity of low-income individuals to access housing, food, health services and transportation services, essential to their livelihood. In transportation, affordability means that people spend less than 20% of their income in transportation and less than 45% on transport and housing combined.

This section refers to affordability from a user perspective, particularly the ability of potential riders to afford fares in the context of their capacity to purchase basic goods and services. The cost of transportation is generally considered affordable if it does not exceed 20% of individual income. The combined cost of housing and transportation is generally considered affordable if it does not exceed 45% of individual income.

According to 2010 U.S. Census figures, the cost of transport in the CER is unaffordable for medium-income households. Based on an estimate of the cost to own and operate a car, the typical household in the CER spends 43% of its income in transportation costs, as depicted in the following table:

Table 5.1 Affordability Analysis

For the municipalities in the INTEDD area, year 2011

AFFORDABILITY ANALYSIS

	Households 2011	No Vehicle	1 Vehicle	2 Vehicles	3+ Vehicles	Annual Cost per Vehicle ($)	Annual Cost per HH ($)	Median HH Income	Affordability Vehicle Cost / Median
Caguas	48,246	5,385	19,450	14,113	5,298	$8,735	$ 8,874	$22,951	38.7%
Humacao	15,904	3,393	6,412	4,389	1,710	$8,735	$ 8,805	$19,040	46.2%
Cayey	13,107	1,978	4,806	4,625	1,698	$8,735	$ 9,840	$27,476	35.9%
Gurabo	18,514	3,433	7,293	5,944	1,844	$8,735	$ 8,990	$18,354	49.0%
San Lorenzo	12,391	2,098	4,951	4,081	1,261	$8,735	$ 9,184	$17,694	51.9%
Juncos	11,396	1,757	5,018	3,451	1,172	$8,735	$ 9,121	$17,680	51.6%
Las Piedras	8,449	1,804	3,380	2,746	839	$8,735	$ 8,648	$15,250	56.7%
Naguabo	13,100	2,677	5,157	3,809	1,327	$8,735	$ 8,748	$17,477	50.1%
	141,107	26,388	66,466	43,268	14,969	$8,735	$ 8,971	$ 20,468	43.8%

Source: Census and AAA for the annual cost of vehicle ownership

The combined effect of urban sprawl, automobile dependence, and high electric, fuel and housing costs presently limit the population's access to transport and housing. In addition, the lack of public transportation alternatives limits CER residents' access to education, health, recreation and work activities offered in the most important centers of economic activity in San Juan.

The Project will make transportation more affordable to CER residents, most of whom currently depend on a private vehicle to travel between Caguas and San Juan. According to Estudios Técnicos' database, the total cost of a 20–km (12 mile) trip between Caguas and San Juan is $9.76 each way, considering the cost of ownership and variable cost of each trip. The perceived cost, however, is $5.60 each way, which only includes some variable cost components, such as gas and maintenance costs. The proposed commuter rail fare is of $2.50 per trip each way. Taking this fare into consideration, the actual cost of a San Juan-Caguas 20-mile trip is reduced by almost 76%, whereas the perceived cost is reduced by 60%.

6 ECONOMIC IMPACT ANALYSIS

The Project will deliver economic impacts from both the initial investment in construction and ongoing operating expenses. Additionally, construction and operations will generate opportunities for local firms.

For purposes of this economic impact analysis, Estudios Técnicos assumed costs that included:

- An initial investment in the Project of $400 million, which includes $25 million of land acquisition costs; and
- Annual operating expenses of $9 million per year.

These numbers represent preliminary Project assumptions and may differ slightly from the analysis presented in other chapters of this Study.

6.1 Impact of the Construction Phase

The initial investment of $400 million includes $225 million of hard construction costs, being the costs associated with actual design and construction activities. These hard construction costs will be incurred over the three-year construction term. Accounting for the impacts of inflation, the distribution of hard construction costs is illustrated in Table 6.1 below.

Table 6.1 Distribution of Hard Construction Costs, by Year

	2014	2015	2016	Total
Investment in construction ($ millions)	$76.83	$79.06	$81.35	**$237.24**

Source: Estudios Técnicos, Inc.

Activity associated with this the construction phase will generate 3,693 full-time jobs, the majority of which would be direct jobs. The number of direct, indirect and induced jobs generated by construction activity are presented in Table 6.2 below.

Table 6.2 Jobs Generated by Construction Activity

Number of Jobs	2014	2015	2016	Total
Direct jobs from construction	637	636	636	**1,909**
Indirect and induced jobs from construction	595	595	594	**1,784**
Total jobs from construction	1,232	1,231	1,230	**3,693**

Source: Estudios Técnicos, Inc.

These jobs represent approximately $131 million in individual income, as illustrated below in Table 6.3.

Table 6.3 Personal Income Generated by Construction Activity

Income (in $ millions)	2014	2015	2016	Total
Income from direct jobs	30.0	15.4	15.9	**61.3**
Income from indirect and induced jobs	34.1	17.6	18.1	**69.8**
Total individual income	64.1	33.0	34.0	**131.1**

Source: Estudios Técnicos, Inc.

Construction activity will generate public sector revenues of $28 million, of which $18 million will revert to the Commonwealth and $10 million will revert to the municipal government. Table 6.4 below summarizes the distribution of public revenues by year.

Table 6.4 Public Sector Revenues

Income (in $ millions)	2014	2015	2016	Total
State construction permit	0.38	0.40	0.41	**1.19**
Municipal construction taxes	0.27	0.28	0.28	**0.83**
Municipal excise taxes	2.69	2.77	2.85	**8.3**
Personal income taxes from construction	4.38	2.25	2.32	**8.96**
Corporate taxes from contractors	1.15	1.19	1.22	**3.56**
Sales taxes from contractors	2.92	1.50	1.55	**5.97**
Public sector revenues from construction	**11.79**	**8.39**	**8.63**	**28.81**
Revenues to municipal government	3.58	3.37	3.46	**10.41**
Revenues to Commonwealth	8.21	5.02	5.16	**18.39**

Source: Estudios Técnicos, Inc.

6.2 Impact of the Operations Phase

The approximate cost of operations is estimated at $9 million per year, of which about 40% or $3.6 million is wages and salaries. Depending on the final mix of workers, the Project's operating phase would generate 128 direct jobs and roughly as many indirect and induced jobs. Please note that in the benefit-cost analysis and financial analysis, more conservative operating costs assumptions were used ($12.8 million versus $9 million). As a result, actual job creation may be higher.

6.3 Regional Jobs and the Creation of Business Opportunities

As part of the Project, a program will be established with the primary objective of maximizing opportunities for local firms and non-profit entities. The program will seek to:

- Define each activity to be undertaken during the construction and operation phases of the Project;
- Identify specific required skill sets to perform these activities;
- Estimate the number of workers required to perform these activities; and
- Coordinate with educational institutions to design training programs relevant to the Project.

It is expected that local residents or employees of local firms and non-profit entities will fill 75% of required jobs for the Project, both during the construction phase and operation phase.

In cases where certain activities have been earmarked for local firms or non-profit entities, and no such firms or entities exist in the region, a program will stimulate their creation potentially via existing incubators. The P3 contract may also include conditions that aim to maximize job creation in the region.

The Project is also expected to generate various wider economic benefits for the CER and SJMA, including various real estate benefits, agglomeration benefits and productivity benefits.

7 FINANCIAL FEASIBILITY

The following section presents the financial feasibility assessment of the Project. The assumptions included in this Study are based on analysis prepared by the Novotrén Office and Estudios Técnicos, Inc. This assessment is subject to change in subsequent stages of the Project, and the Authority is presently in the process of selecting technical advisors who may provide new cost data related to construction, operations, maintenance, life-cycle replacement and other costs. Additionally, underlying business and financial assumptions regarding fares, revenue, ridership and financial structure may also change as the understanding of demand for the Project evolves. The Authority will work closely with the P3 Committee to analyze changes and the impact to financial feasibility.

7.1 Basic Assumptions and Sensitivities

7.1.1 Revenue Estimates

Table 7.1 below summarizes the key assumptions adopted in the development of revenue estimates for the Project. High, low and downside scenarios were also considered to test the Project's sensitivity to various revenue assumptions, and are also summarized below.

Table 7.1 Summary of Revenue Assumptions, Estimates and Sensitivities

Revenue Assumptions	
Base case ridership	10,500 initial daily weekday trips
Capture rate	4.1% of total corridor trips
Ridership growth	Ramp up occurs over the first three (3) years and then increases to maximum capacity of 22,700 at year 12 of operations
Fare assumptions	• $2.50 per trip in year one, increasing 50 cents every 3 years • Transfer costs with Tren Urbano are estimated to be $0.25 beginning in year 6
Revenue Estimates	
First year revenues	• $7.9 million
Sensitivities	
	• High revenue estimate of 15,400 initial daily weekday trips has been analyzed • Low estimate of 7,350 trips has been analyzed. • A "downside" scenario has also been considered which has initial daily weekday trips at approximately 5,000.

7.1.2 Operating Cost Assumptions

Table 7.2 below summarizes the key assumptions adopted in the development of operating cost estimates for the Project. High, low and downside scenarios were also considered to test the Project's sensitivity to various revenue assumptions, and are also summarized below.

Table 7.2 Summary of Operating Cost Assumptions, Estimates and Sensitivities

Operating Cost Assumptions	
Benchmarked Costs	• Operating costs have been developed on the basis of historical costs of operating Tren Urbano.
Adjustments	• Costs are adjusted using a 2.4% inflation rate (PR *Consumption Expenditures Deflator 2008-2012*, Puerto Rico Planning Board). • Costs are also adjusted based on ridership assumptions discussed above.
Operating Cost Estimates	
First year costs	• The initial operating cost is estimated to be $12.8 million by Estudios Técnicos.
Sensitivities	
	• Analysis takes variations of ridership into account as well as 10% cost overrun and 10% cost savings.

7.1.3 Construction cost assumptions

Table 7.3 below summarizes the key assumptions adopted in the development of construction cost estimates for the Project. Variations to capital costs were also considered to test the Project's sensitivity to various revenue assumptions, and are also summarized below.

Table 7.3 Summary of Construction Cost Assumptions, Estimates and Sensitivities

Construction Cost Assumptions	
Base case construction cost	$400 million
Cost Breakdown (per the Novotrén Office)	
Site work and stations	$175 million
Required land acquisitions	$25 million
Rail and communications	$100 million
Train vehicles	$100 million
Sensitivities	
	• Analysis considers variations in construction costs into account, with sensitivity amounts of $400 million and $500 million.

7.1.4 Funding and Financing Assumptions

Table 7.4 below summarizes the key funding and financing assumptions for the Project. A range of scenarios were also considered to test the Project's sensitivity to various assumptions, and are also summarized below.

Table 7.4 Summary of Funding and Financing Assumptions, Estimates and Sensitivities

Funding Assumptions	
Funding sources	• The Commonwealth is anticipated to provide $20 million per year for the first 10 years of operations. • Additional annual subsidies for operations and the balance of capital costs to be provided by AMC and/or the Commonwealth.
Financing Assumptions	
Structure of financing package	• Analysis has considered fixed-rate debt at 7.5% and a return on equity of 14%. • Debt matures in 25 years. • Debt : Equity ratio is 75:25.
Sensitivities	
	The following scenarios were run to stress the various assumptions used in the financial analysis: • Base Case with Low Capital Cost • High Revenue with High Capital Cost • High Revenue with Low Capital Cost • Low Revenue with High Capital Cost • Low Revenue with Low Capital Cost • Downside Revenue with High Capital Cost • Downside with Low Capital Cost

7.2 Financial Results

Over the term of the operating period in Base Case with Low Capital Cost scenario, the subsidy to be provided in any year by AMC and/or the Commonwealth (in addition to the $20 million per year for the first 10 years) ranges from a low of $11 million (in year 30 of operations) to a high $39 million (in year 11 of operations) in the base case (per the assumptions above). The average subsidy over 30 years is $23 million, and the year 1 subsidy is $26 million.

Across all sensitivity scenarios the lowest subsidy requirement is approximately $11 million and the largest is $57 million (Downside Revenue and High Capital Costs). The average subsidy is $29 million.

As stated, these estimates are subject to change; however, they provide a reasonable planning benchmark.

8 CONCLUSION

8.1 Key Findings

The key findings of the Study fall into three groups:

- The need for investment in commuter rail transportation in the PR-52 corridor;
- The delivery model to facilitate the investment; and
- Preliminary benefit-cost analysis and financial feasibility.

Based on the findings noted below, the Authority considers that the Project is ready to move to the procurement phase.

8.2 Need for Investment

AMC is located south of San Juan and with its access to PR-52, PR-1 and PR-30 is considered a gateway between the Central Eastern Region ("CER") and the San Juan Metropolitan Area ("SJMA"). However, the vital routes which connect the north and south shores of Puerto Rico and also help many people who live in the CER get to work in the SJMA, suffer significant delays as a result of severe traffic congestion conditions, not just during peak rush-hour periods, but for most of the day. There are more than 160,000 daily trips being made in the PR-52 transportation corridor, which is beyond its design capacity and the resulting congestion making journey time between 45 and 55 minutes for a 24 km (15 mile) journey.

Congestion relief is only part of the need for this corridor. The train system will also help to reduce vehicle emissions (as less cars are sitting in traffic) and improve safety. With fewer vehicles on the road, there will be less stop-and-go traffic which often results in accidents and further traffic delays.

It is clear that an alternative transportation solution is needed for the corridor and the Authority, DTPW, PRHTA and AMC believe this Project is that solution.

8.3 Delivery Model

A qualitative analysis of a range of potential delivery models was described in chapter 3. The conclusion of the qualitative analysis is that a Design, Build, Finance, Operate and Maintain (DBFOM) delivery model is the most suitable option for the Project. This model will help the Commonwealth transfer significant risk to the private sector and significantly reduce interface risk between phases as one entity will be held accountable for the development and delivery of the Project.

While the use of the DBFOM model would facilitate the transfer of several of the key risk groups in the Project to improve outturn cost and schedule certainty, it is not anticipated that risks related to ridership and revenue from the Project will be able to be transferred. As a result, an Availability Payment mechanism is being contemplated as the means for compensating the private sector in place of Project revenues.

It is important to note that there are several recent, directly-relevant examples of new-build rail projects which were developed as DBFOM P3s with Availability Payments. This includes the Denver Eagle P3, the Canada Line, the Southeast to West Light Rail Project and the Maryland Purple Line.

8.4 Preliminary Benefit-Cost Analysis and Financial Feasibility

The benefit-cost analysis described in Chapter 4 shows that the anticipated quantifiable benefits from the Project exceed their anticipated costs regardless of the high/low cost scenarios presented. It is important to note this analysis does not include all of the potential benefits that the Project investments will contribute to the regional economy, for example through improved land values. So, indeed, the benefits

are even greater. The benefit-cost ratios were tested for a range of capital expenditure and ridership scenarios. All scenarios demonstrated strong benefit-cost ratios that exceeded the threshold ratio of one.

A preliminary financial feasibility analysis was performed based on a range of capital cost, operating and maintenance cost and ridership scenarios to aid decision making and planning for the Project. Additionally, a downside revenue scenario was also developed to understand the impact of Project revenue if ridership is significantly below expectations. Based on the output of all sensitivity scenarios, the lowest net subsidy requirement in any year of operations ranges from approximately $11 million to $57 million.

As noted in chapter 7, these estimates are subject to change; however, they provide a reasonable planning benchmark for establishing levels of funding.

9 REFERENCES

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10 APPENDIX A: GENERAL PARAMETERS OF BENEFIT-COST ANALYSIS

General Economic Parameters

	Year of Current Dollars for Model	2013
1	Economic Update Factor (Using GDP Deflator)	1.64
	Real Discount Rate	6.0%

Travel Time Parameters

		Value	Units
2	Statewide Average Hourly Wage	$ 10.00	$/hr
	Value of Time		
	Automobile	$ 5.00	$/hr/per
	Truck	$ 10.00	$/hr/veh
	Auto & Truck Composite	$ 6.80	$/hr/veh
	Transit	$ 5.00	$/hr/per
	Out-of-Vehicle Travel	2	times
	Incident-Related Travel	3	times

Vehicle Operating Cost Parameters

3	Average Fuel Price		
	Automobile (regular unleaded)	$ 3.51	$/gal
	Truck (diesel)	$ 3.54	$/gal
4	Sales and Fuel Taxes		
	State Sales Tax	5.50%	%
	Average Local Sales Tax	1.50%	%
	State Fuel Excise Tax	$ 0.10	$/gal
	Fuel Cost Per Gallon (Exclude Taxes)		
	Automobile	$ 3.20	$/gal
	Truck	$ 3.20	$/gal
	Non-Fuel Cost Per Mile		
	Automobile	$ 0.392	$/mi
	Truck	$ 0.590	$/mi
	Idling Speed for Op. Costs and Emissions	5	mph

Accident Cost Parameters

5	Cost of a Fatality	$ 2,240,436	$/event
	Cost of an Injury		
	Level A (Severe)	$ 155,107	$/event
	Level B (Moderate)	$ 31,021	$/event
	Level C (Minor)	$ 16,372	$/event
	Cost of Property Damage	$ 1,723	$/event
5	Cost of Highway Accident		
	Fatal Accident	$ 2,240,436	$/accident
	Injury Accident	$ 31,021	$/accident
	PDO Accident	$ 1,723	$/accident
	Average Cost	$ 52,100	$/accident
6	Statewide Highway Accident Rates		
	Fatal Accident	0.009	per mil veh-mi
	Injury Accident	0.31	per mil veh-mi
	PDO Accident	0.65	per mil veh-mi
	Non-Freeway	1.25	per mil veh-mi

7 PROJECT DATA

Type of Project	Enter data in both sections 1B & 1E	
Select project type from list	Passenger Rail	
Project Location (enter 1 for So. Cal., 2 for No. Cal., or 3 for rural)	2	
Length of Construction Period	3	years
One- or Two-Way Data	2	enter 1 or 2
	Current	
Length of Peak Period(s) (up to 24 hrs)	5	hours

7 HIGHWAY DESIGN AND TRAFFIC DATA

		No Build	Build
Highway Design			
Roadway Type (Fwy, Exp, Conv Hwy)		C	C
Number of General Traffic Lanes		3	3
HOV Restriction (2 or 3)		1	
Exclusive ROW for Buses (y/n)		N	
Highway Free-Flow Speed		50	55
Ramp Design Speed (if aux. lane/off-ramp proj.)			
Length (in miles)	Highway Segment	15	15
	Impacted Length	15	15

Average Daily Traffic			
	Current	174,300	
		No Build	Build
	Base (Year 1)	174,300	167,300
	Forecast (Year 20)	191,730	191,730
Average Vehicle Occupancy (AVO)		No Build	Build
General Traffic	Non-Peak	1.65	1.65
	Peak	1.33	1.33
High Occupancy Vehicle (if HOV/HOT lanes)		2.15	2.15

7

HIGHWAY ACCIDENT DATA

Statewide Basic Average Accident Rate	No Build	Build
Rate Group		
Accident Rate (per million vehicle-miles)	7.77	7.75
Percent Fatal Accidents (Pct Fat)	0.6%	0.6%
Percent Injury Accidents (Pct Inj)	13.5%	13.5%

7

RAIL AND TRANSIT DATA

Annual Person-Trips		No Build	Build
Ridership	Base (Year 1)	0	5,040,000
	Forecast (Year 20)	0	5,544,000
Percent Trips during Peak Period		41%	
Percent New Trips from Parallel Highway			100%

Annual Vehicle-Miles		No Build	Build
	Base (Year 1)	15.12	15.12
	Forecast (Year 20)	15.12	15.12
Average Vehicles/Train (if rail project)		10	10

Reduction in Transit Accidents	
Percent Reduction (if safety project)	2.5%

Average Transit Travel Time		No Build	Build
In-Vehicle	Non-Peak (in minutes)	35.0	35.0
	Peak (in minutes)	45.0	35.0
Out-of-Vehicle	Non-Peak (in minutes)	5.0	5.0
	Peak (in minutes)	5.0	5.0

7

Col. no.

Year	TOTAL COSTS (in dollars) Constant Dollars	Present Value
Construction Period		
1	$133,333,333	$133,333,333
2	133,333,333	125,786,163
3	133,333,334	118,666,193
Total	$400,000,000	$377,785,689

Source: Refer to the list of sourced parameters to follow (ETI database)

11 APPENDIX B: SUMMARY OF TRAVEL TIME BENEFITS

SUMMARY OF TRAVEL TIME BENEFITS

Year	Peak Non-HOV	Peak Truck	Non-Peak Non-HOV	Non-Peak Truck	TRANSIT Peak In-Vehicle	TRANSIT Peak Out-of-Veh	TRANSIT Non-Peak In-Vehicle	TRANSIT Non-Peak Out-of-Veh	Present Value of Travel Time Benefits	Constant Dollars	Total Per-Hrs of Time Saved
1	$17,093,879	$1,447,451	$30,930,578	$2,082,917	$8,744,615	($1,445,824)	$12,583,714	($2,080,577)	$69,356,753	$82,605,003	16,520,528
20	$6,492,928	$548,260	$11,741,918	$788,959	$3,179,230	($525,650)	$4,574,989	($756,423)	$26,044,212	$93,851,291	18,750,386
2	$16,252,971	$1,376,015	$29,407,981	$1,980,118	$8,293,056	($1,371,164)	$11,933,910	($1,973,139)	$65,899,748	$83,196,913	16,637,889
3	$15,452,491	$1,308,028	$27,958,653	$1,882,284	$7,864,599	($1,300,324)	$11,317,350	($1,871,197)	$62,611,883	$83,788,823	16,755,250
4	$14,690,557	$1,243,329	$26,579,177	$1,789,180	$7,458,076	($1,233,110)	$10,732,353	($1,774,475)	$59,485,087	$84,380,733	16,872,611
5	$13,965,370	$1,181,763	$25,266,289	$1,700,586	$7,072,376	($1,169,338)	$10,177,322	($1,682,707)	$56,511,660	$84,972,643	16,989,972
6	$13,275,211	$1,123,184	$24,016,870	$1,616,289	$6,706,445	($1,108,836)	$9,650,738	($1,595,642)	$53,684,259	$85,564,552	17,107,333
7	$12,618,439	$1,067,450	$22,827,942	$1,536,086	$6,359,280	($1,051,436)	$9,151,159	($1,513,042)	$50,995,878	$86,156,462	17,224,694
8	$11,993,484	$1,014,426	$21,696,660	$1,459,784	$6,029,930	($996,982)	$8,677,216	($1,434,681)	$48,439,838	$86,748,372	17,342,055
9	$11,398,850	$963,985	$20,620,307	$1,387,199	$5,717,489	($945,323)	$8,227,606	($1,360,343)	$46,009,771	$87,340,282	17,459,416
10	$10,833,106	$916,005	$19,596,290	$1,318,153	$5,421,099	($896,318)	$7,801,094	($1,289,824)	$43,699,605	$87,932,192	17,576,777
11	$10,294,887	$870,367	$18,622,132	$1,252,480	$5,139,944	($849,832)	$7,396,505	($1,222,930)	$41,503,553	$88,524,102	17,694,138
12	$9,782,889	$826,961	$17,695,469	$1,190,018	$4,873,249	($805,737)	$7,012,725	($1,159,476)	$39,416,098	$89,116,012	17,811,499
13	$9,295,868	$785,681	$16,814,047	$1,130,614	$4,620,278	($763,911)	$6,648,692	($1,099,287)	$37,431,981	$89,707,922	17,928,859
14	$8,832,638	$746,424	$15,975,712	$1,074,122	$4,380,330	($724,239)	$6,303,402	($1,042,197)	$35,546,193	$90,299,832	18,046,220
15	$8,392,065	$709,094	$15,178,412	$1,020,403	$4,152,744	($686,610)	$5,975,900	($988,048)	$33,753,959	$90,891,741	18,163,581
16	$7,973,068	$673,598	$14,420,185	$969,324	$3,936,887	($650,920)	$5,665,277	($936,690)	$32,050,729	$91,483,651	18,280,942
17	$7,574,617	$639,849	$13,699,165	$920,759	$3,732,162	($617,071)	$5,370,672	($887,981)	$30,432,171	$92,075,561	18,398,303
18	$7,195,728	$607,762	$13,013,567	$874,585	$3,537,999	($584,969)	$5,091,267	($841,784)	$28,894,156	$92,667,471	18,515,664
19	$6,835,463	$577,258	$12,361,692	$830,689	$3,353,859	($554,523)	$4,826,285	($797,972)	$27,432,751	$93,259,381	18,633,025
Total	**$220,244,507**	**$18,626,890**	**$398,423,045**	**$26,804,549**	**$110,573,649**	**($18,282,118)**	**$159,118,177**	**($26,308,414)**	**$889,200,284**	**$1,764,562,939**	**352,709,142**

Formulas:

Avg. Annual Volume = Avg. Daily Traffic x Number of Days in Model Year
vehicles / yr

TT Savings = Travel Time Reduction x Avg. Value of Time
$ / year $/hour

Avg. Value of Time (varies by vehicle type)

Travel Time = AVO x Avg. Annual Volume x Affected Length / Speed
vehicle-hrs / yr vehicles / yr x miles miles/hour

Induced = Change in Trips x Change in Travel Time * 0.5

Source: Estudios Técnicos, Inc.

12 APPENDIX C: SUMMARY OF VEHICLE OPERATING COST BENEFITS

SUMMARY OF VEHICLE OPERATING COST BENEFITS

Year	Peak Non-HOV	Peak Truck	Non-Peak Non-HOV	Non-Peak Truck	Present Value of Veh Op Cost Benefits	Constant Dollars
1	$32,183,571	$1,294,873	$42,156,379	$1,863,354	$77,498,178	$92,301,570
20	$8,232,493	$123,262	$10,335,580	$177,378	$18,868,714	$67,994,116
2	$30,000,621	$1,175,803	$39,229,699	$1,692,009	$72,098,132	$91,022,230
3	$27,961,682	$1,066,063	$36,499,274	$1,534,090	$67,061,108	$89,742,890
4	$26,057,444	$964,979	$33,952,261	$1,388,628	$62,363,312	$88,463,551
5	$24,279,191	$871,923	$31,576,647	$1,254,719	$57,982,480	$87,184,211
6	$22,618,763	$786,310	$29,361,187	$1,131,519	$53,897,779	$85,904,871
7	$21,068,517	$707,595	$27,295,363	$1,018,247	$50,089,722	$84,625,532
8	$19,621,301	$635,272	$25,369,333	$914,172	$46,540,078	$83,346,192
9	$18,270,417	$568,870	$23,573,890	$818,618	$43,231,794	$82,066,852
10	$17,009,597	$507,949	$21,900,421	$730,951	$40,148,919	$80,787,513
11	$15,832,973	$452,103	$20,340,872	$650,587	$37,276,534	$79,508,173
12	$14,735,053	$400,951	$18,887,707	$576,978	$34,600,688	$78,228,833
13	$13,710,698	$354,141	$17,533,879	$509,618	$32,108,335	$76,949,494
14	$12,755,096	$311,346	$16,272,798	$448,035	$29,787,275	$75,670,154
15	$11,863,747	$272,261	$15,098,303	$391,790	$27,626,101	$74,390,814
16	$11,032,438	$236,603	$14,004,632	$340,478	$25,614,151	$73,111,474
17	$10,257,228	$204,110	$12,986,398	$293,719	$23,741,455	$71,832,135
18	$9,534,430	$174,537	$12,038,565	$251,163	$21,998,695	$70,552,795
19	$8,860,594	$147,658	$11,156,426	$212,483	$20,377,161	$69,273,455
Total	**$355,885,853**	**$11,256,609**	**$459,569,614**	**$16,198,535**	**$842,910,612**	**$1,602,956,854**

Formulas:

Vehicle-Miles Traveled = Affected Length x Avg. Annual Volume			Non-Fuel Cost = VMT x Cost Per Mile		
veh-miles/yr	miles	vehicles/yr	dollars	$/miles	
Fuel Cost = VMT x Fuel Consumption x Fuel Price			Benefit = Existing Cost - New Cost		
dollars	gallons/mile	$/gallon			

Source: Estudios Técnicos, Inc.

13 APPENDIX D: SUMMARY OF ACCIDENT REDUCTION BENEFITS

SUMMARY OF ACCIDENT REDUCTION BENEFITS

Year	Peak Non-HOV	Peak Truck	Non-Peak Non-HOV	Non-Peak Truck	Present Value of Accident Benefits	Constant Dollars
1	$1,022,179	$21,808	$1,301,305	$31,382	$2,376,675	$2,830,657
20	$230,081	$479	$269,419	$689	$500,668	$1,804,175
2	$948,131	$19,563	$1,203,508	$28,151	$2,199,353	$2,776,632
3	$879,191	$17,502	$1,112,613	$25,185	$2,034,490	$2,722,607
4	$815,017	$15,611	$1,028,151	$22,465	$1,881,245	$2,668,581
5	$755,292	$13,879	$949,687	$19,972	$1,738,829	$2,614,556
6	$699,716	$12,292	$876,811	$17,689	$1,606,509	$2,560,531
7	$648,012	$10,841	$809,142	$15,601	$1,483,597	$2,506,505
8	$599,920	$9,515	$746,325	$13,692	$1,369,452	$2,452,480
9	$555,195	$8,304	$688,027	$11,950	$1,263,476	$2,398,454
10	$513,612	$7,200	$633,937	$10,361	$1,165,109	$2,344,429
11	$474,957	$6,194	$583,766	$8,913	$1,073,831	$2,290,404
12	$439,033	$5,279	$537,244	$7,596	$989,152	$2,236,378
13	$405,654	$4,447	$494,118	$6,400	$910,620	$2,182,353
14	$374,647	$3,693	$454,153	$5,315	$837,808	$2,128,328
15	$345,851	$3,010	$417,129	$4,332	$770,322	$2,074,302
16	$319,114	$2,393	$382,841	$3,443	$707,791	$2,020,277
17	$294,296	$1,836	$351,099	$2,641	$649,872	$1,966,251
18	$271,265	$1,334	$321,723	$1,919	$596,241	$1,912,226
19	$249,898	$883	$294,548	$1,270	$546,600	$1,858,201
Total	**$10,841,061**	**$166,062**	**$13,455,548**	**$238,967**	**$24,701,638**	**$46,348,328**

Formulas:

Vehicle-Miles Traveled = Affected Length x Avg Volume
veh-miles/yr — miles — vehicles/yr

Transit Acc Cost = Veh-Miles x Acc Cost/Mile

Hwy Acc Cost = (VMT x Rate x Cost/Mile) by Acc Type

Transit Acc Cost/Mile from PARAMETERS

Source: Estudios Técnicos, Inc.

14 APPENDIX E: SUMMARY OF EMMISSION REDUCTION BENEFITS

SUMMARY OF EMISSION REDUCTION BENEFITS

Year	Peak Non-HOV	Peak Truck	Non-Peak Non-HOV	Non-Peak Truck	Present Value of Emission Benefits	Constant Dollars
1	$4,433,417	$1,458,373	$5,907,503	$2,098,634	$13,897,927	$16,552,653
20	$1,374,651	$50,837	$1,798,985	$73,156	$3,297,629	$11,883,128
2	$4,188,592	$1,343,575	$5,575,098	$1,933,437	$13,040,702	$16,463,586
3	$3,957,404	$1,237,011	$5,261,447	$1,780,088	$12,235,951	$16,374,462
4	$3,739,083	$1,138,118	$4,965,481	$1,637,780	$11,480,461	$16,285,254
5	$3,532,901	$1,046,372	$4,686,191	$1,505,755	$10,771,219	$16,195,931
6	$3,338,174	$961,283	$4,422,627	$1,383,309	$10,105,393	$16,106,462
7	$3,154,257	$882,392	$4,173,895	$1,269,784	$9,480,328	$16,016,815
8	$2,640,623	$175,761	$3,509,731	$252,925	$6,579,040	$11,782,058
9	$2,500,758	$160,549	$3,319,989	$231,034	$6,212,330	$11,792,857
10	$2,368,326	$146,417	$3,140,468	$210,697	$5,865,908	$11,803,359
11	$2,242,926	$133,294	$2,970,611	$191,813	$5,538,643	$11,813,528
12	$2,124,179	$121,112	$2,809,893	$174,284	$5,229,468	$11,823,325
13	$2,011,728	$109,810	$2,657,818	$158,020	$4,937,376	$11,832,709
14	$1,905,234	$99,329	$2,513,917	$142,937	$4,661,417	$11,841,638
15	$1,804,379	$89,613	$2,377,746	$128,956	$4,400,694	$11,850,069
16	$1,708,859	$80,612	$2,248,888	$116,003	$4,154,362	$11,857,958
17	$1,618,389	$72,277	$2,126,947	$104,009	$3,921,622	$11,865,257
18	$1,532,699	$64,564	$2,011,548	$92,909	$3,701,720	$11,871,918
19	$1,451,533	$57,430	$1,902,339	$82,644	$3,493,946	$11,877,893
Total	**$51,628,111**	**$9,428,730**	**$68,381,122**	**$13,568,172**	**$143,006,135**	**$267,890,859**

Formulas:

Vehicle-Miles Traveled = Affected Length x Avg. Annual Volume
veh-miles/yr miles vehicles/yr

Hwy Emissions Cost = (VMT x Rate x Cost/Mile) by Emissions Type

Transit Em Cost = (Veh-Miles x Rate x Cost/Mile) by Em Type

Source: Estudios Técnicos, Inc.