CAMBRIDGE SYSTEMATICS

Economic Impact Analysis for Future Regional Plans

Final Report

prepared for

Metropolitan Transportation Commission

prepared by

Cambridge Systematics, Inc.

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final report

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1.0 Introduction

Plan Bay Area is the region's first integrated Regional Transportation Plan (RTP) and Sustainable Communities Strategy (SCS) prepared by the Metropolitan Transportation Commission (MTC) and Association of Bay Area Governments (ABAG). Adopted July 18, 2013, *Plan Bay Area* specifies a detailed transportation investment and land use strategy through 2040. To initiate the process of developing a preferred scenario that led to *Plan Bay Area*, ABAG developed five alternative land use scenarios that were paired with one of two alternative transportation investment scenarios developed by MTC.

Through an outreach process with stakeholders, ABAG and MTC selected 10 performance measures used to evaluate the outcomes of five alternative scenarios and the development of the preferred scenario for *Plan Bay Area*. Based on input from business stakeholders, the performance measures included the impact on Gross Regional Product (GRP).

While this was one step to identify the impact of *Plan Bay Area* on the Bay Area economy, results of the GRP performance measures assessment did not yield significant differences among the five alternatives evaluated. MTC directed Cambridge Systematics, Inc. (CS) to develop an analytical report with recommended options for MTC and ABAG that could better evaluate economic impacts of the next iteration of *Plan Bay Area* in 2017. In this report, we make a clear distinction between measuring economic impacts versus promoting economic development. MTC and ABAG must balance the role of future Plans to foster economic development, environmental improvements, and equity. The goal here is to explain how a variety of measures could be used to evaluate how the land use patterns and transportation investment strategies contained in the next Plan might impact the regional economy. This initial review can be used to foster further discussions with business and other stakeholders in the development of the next plan.

In the following subsections of this introduction, we first describe the GRP performance assessment method used for *Plan Bay Area* and its limitations. We then describe the outreach process MTC and ABAG used to gather input from business stakeholders. Finally, we explain several measures that MTC and ABAG may apply in the next RTP/SCS cycle, providing brief summaries of five specific economic impact analyses recommended for consideration. Appendix B to the report describes best practices from around the U.S. that illustrate possible approaches to linking transportation and land use planning to regional economic development. Many of the case studies employ robust economic analysis methods, effective outreach to stakeholders with economic interests, and integration of the measurements of economic impacts with other measures. Aspects of these examples may be useful to incorporate into the planning process for the 2017 Plan.

1.1 ECONOMIC ANALYSIS OF *PLAN BAY AREA*

Plan Bay Area will specify how $292 billion should be spent in the Bay Area to improve transportation in the 28-year horizon of the plan. The plan also identifies transportation and land use policies intended to leverage these investments and achieve a more sustainable land use pattern. Through extensive outreach, MTC and ABAG worked with stakeholders to develop a set of 10 measures used to evaluate the performance of five scenarios (see *Plan Bay Area Performance Assessment Report*). The measure of economic impact used in that scenario analysis is a forecast of Gross Regional Product (GRP) in 2035. GRP is the market value of all final goods and services produced in a given year within the nine Bay Area counties. GRP is one measure of the size of our economy. GRP includes wages and benefits, proprietor's income (which captures the output of the self-employed), and other property-type income that includes profits. Note that profits may be repatriated to a Bay Area firm's headquarters outside the nine counties.[1]

In addition to GRP, MTC and ABAG considered including other measures, such as employment by industry and median household income. Median household income is the amount which divides the Bay Area's households into two equal groups: one-half having income above that amount, and one-half having income below that amount. The median income is a better indicator of the distribution of wealth than average income because it is more sensitive to unusually high or low values. While these measures were reported, they were not formally included in the evaluation of the five scenarios or the preferred scenario.

The following brief summary will provide basic principles that should help the reader's understanding of the analytical methods we used in our economic analysis of *Plan Bay Area*, as well as those proposed for consideration in the next Plan.

Effects from Transportation Investments

Our analysis of economic impacts from *Plan Bay Area* transportation investments starts with the reduction in business operating costs through lower congestion, accidents, and vehicle operating costs; the effects from expanding businesses' access to customer or supplier markets; and shortened commutes, thus, increasing the size and diversity of the labor pool from which businesses can recruit workers.

In a mature economy with high levels of congestion like the Bay Area, the vast majority of direct benefits from transportation improvements are from the reduction of business operating costs. When the region's businesses spend less

[1] Profits for the finance, insurance, and real estate (FIRE) industries, for example, constitute a significant share of their output.

on transportation per unit of output, they can compete against similar firms located outside the region and capture greater market share. As these local firms increase their production, they hire more workers (i.e., direct employment and primary-income generation); and they buy more inputs, which causes their suppliers to hire more workers (indirect employment and secondary-income generation). In turn, these additional workers (direct plus indirect employment and income) consume products and services that require more workers (e.g., retail clerks, school teachers, etc.), which boost the region's output, income, and employment further (i.e., induced impacts).

Effects from Land Use Policies

Changes in land use can generate economic benefits when businesses are concentrated closer together (i.e., agglomeration); and have closer access to a larger and more diverse pool of labor (i.e., labor market matching). Agglomeration impacts of land use policies are in addition to the direct travel savings derived from transportation investments. Agglomeration effects may be divided into five types. The first four of the five agglomeration effects involve business-to-business interactions that result from higher concentration of employment. *Plan Bay Area* policies concentrate employment into Priority Development Areas (PDAs) that increase the number and size of firms interacting in close proximity to one another. Empirical research indicates that employment density increases worker and firm interactions, which results in increased business productivity.[2] In particular, these agglomeration effects consist of:

- **Sharing benefits** are closely tied to economies of scale. Large pools of customers allow for economic activities that would otherwise be unprofitable. A simple example for a typical PDA would be an office supply store, which is poorly supported by a small number of businesses in a low-density office development, but becomes profitable in a high-density commercial development. These are called sharing benefits precisely because demand can be shared across a large number of companies or people.
- **Knowledge spillovers** occur as people interact. They share ideas and knowledge and collaborate to create new knowledge. Proximity is a key to knowledge diffusion, although it has emerged that proximity can be measured in ways other than spatial distance. With economic density, the potential for interactions increases and can improve the pace and breadth of learning and knowledge accumulation. This knowledge, over time, gets embodied in worker skills and production techniques to improve firms' productivity.

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[2] Krugman, P. (1991). "Increasing Returns and Economic Geography," *Journal of Political Economy*, 99, 483-499.

- **Competition** is a driving force in innovation. Industrial clustering can speed knowledge growth by forcing firms to innovate or fail. Clustering expands customers' access to the number of firms that directly compete with each other for their business. As the number of market participants increases, two things happen: 1) poor performers are more likely to be driven out of business, and 2) remaining firms feel more pressured to innovate – to actively acquire knowledge. Both effects can lead to higher rates of innovation and productivity.
- **Matching benefits** are closely tied to economic specialization. They capture the fact that good economic fits facilitate productivity. The benefits of specialization arise from matching specialized products and services to specialized needs. Urban areas bring firms and industries near one another. As this pool of firms grows, odds increase that a firm needs a specialized input. For example, a manufacturer needing a specific metal alloy may be more likely to find it in a cluster of metal fabricators. The correct metal alloy may allow a manufacturer to eliminate a downstream production cost.
- **Access to labor** is a fifth agglomeration effect that involves the size and proximity, measured in distance or commute time, of jobs to housing. This effect is generated from both transportation investments that shorten commute times, and land use policies that locate higher density residential development nearer to job centers. A larger labor pool in closer proximity to employment opportunities increases the quality of employment-worker matches. As the pool of accessible labor grows, odds increase that firms will find a good fit for their specialized skill needs. Good matches lead to higher productivity because they are more efficient.

All of the growth in GRP and employment gains in *Plan Bay Area* represent benefits for the nine-county region as a whole as opposed to redistribution among the counties. In this analysis, CS measured the aggregate economic activity of all nine counties, and did not isolate the output of any single county. When *Plan Bay Area* investments and policies create more competitive conditions for the region, the resultant expansion of the Bay Area's economy comes at the expense of other regions, both domestic and foreign, where firms compete with Bay Area businesses for market share. Because the aggregate demand from all consumers globally is fixed, all economic growth is redistributive.

Limitations of the *Plan Bay Area* Economic Impact Analysis

The methodology employed to measure the economic impacts of *Plan Bay Area* is designed to measure the difference between a "no-project" base case scenario and a set of alternative scenarios that vary in their level of investment and policies. *Plan Bay Area* did not include such a base case scenario, which meant that the final preferred scenario could not be measured relative to a base case or benchmark. Instead, the projected outcomes were presented as absolute forecasts of Gross Regional Product (GRP) growth. Such forecasts, especially over a 25-year period, are unreliable because regional, national, and global

economies are buffeted by a multitude of significant and unpredictable market forces.

Furthermore, *Plan Bay Area's* $292 billion of regional transportation investments over 25 years amount to less than one-third of one percent of the Bay Area's annual GRP. This level of investment will have modest impacts at best, which are hard to measure in absolute terms, but can be isolated when measured relative to a base case scenario. The impacts of the SCS land use policies, assuming they are fully implemented, also are modest since they are applied only to new development and redevelopment, which is a small fraction of the existing land use in a largely built-out region. The isolation of different outcomes between different scenarios (i.e., deltas) may be measured in absolute or percentage terms, and provide decision-makers and stakeholders with a more controlled evaluation of each alternative scenario performance while holding all other influences constant. Analyzing the performance of different scenarios relative to a base case provides a reasonable basis for comparison[3].

1.2 BUSINESS STAKEHOLDER INVOLVEMENT

MTC and ABAG launched and maintained an active outreach effort throughout the *Plan Bay Area* process. This included inviting leaders and experts in the region's business community to participate in stakeholder meetings or soliciting their opinions individually. Through this effort, stakeholders requested that future updates to *Plan Bay Area* evaluate economic impacts in greater depth. To address this request, CS developed a draft scope of work for this project, proposing several economic impact measures to be evaluated for consideration in the next Plan. The draft workscope was discussed at a meeting with business stakeholders, as well as regional agency staff, including the following organizations:

- Bay Area Council;
- Bay Area Council Economic Institute;
- Silicon Valley Leadership Group;
- Bay Planning Coalition;
- Building Industry Association of the Bay Area;
- Contra Costa Council;

[3] GRP analysis, along with analysis for the other nine *Plan Bay Area* performance measures, was also conducted for the alternatives included in the *Plan Bay Area* Draft Environmental Impact Report, which includes a "no project" alternative. A no project or base-case scenario provides a useful point of comparison when assessing the performance of multiple scenarios and is recommended for performance measure analyses in future Plans.

- East Bay Economic Development Alliance;
- Jobs and Housing Coalition;
- North Bay Leadership Council;
- San Mateo County Economic Development Corporation (SAMCEDA);
- Solano Economic Development Alliance;
- ABAG;
- Bay Area Air Quality Management District (BAAQMD);
- Bay Conservation and Development Commission (BCDC);
- MTC; and
- Joint Policy Committee (JPC).

1.3 TOPICS FOR ECONOMIC ANALYSIS IN THE NEXT *PLAN BAY AREA*

Discussion at the business stakeholder meeting focused on refining and vetting five measures of economic impact of the regional economy based on transportation investments and land use policies that could be included in the next Plan:

- **State of Good Repair (SGR).** *Plan Bay Area* allocates about 87 percent of the $292 billion to operations and maintenance of existing transit and roadway infrastructure. Despite this level of investment, the Plan forecasts that distressed lane-miles of roadways will increase 51 percent over the next 25 years, compared to the performance target reduction of 63 percent. For transit, the forecast shows a 78-percent increase in assets past their useful life, compared to a target of 100-percent reduction. The direct consequences of a diminishing SGR include more wear and tear on vehicles from rougher roads; and in extreme cases, slower speeds. For transit, delays in vehicle and equipment replacement and rehabilitation may mean more unscheduled service outages, broken escalators, and noisy tracks. Section 2.0 of this report presents how the next update to *Plan Bay Area* could evaluate the economic impacts of this outcome versus that of alternative investment levels in SGR.
- **Roadway Pricing.** Section 3.0 of this report presents a framework for measuring the regional economic effects of pricing on the Bay Area regional economy, and provides recommendations on how the next Plan can evaluate the economic effects of pricing strategies. In this section, we focus on the effects of roadway pricing on reducing traffic congestion. From an economic impacts perspective, reducing congestion has both positive and negative consequences. On one hand, pricing increases costs on businesses and households, which reduce spending on investment and consumption, and

suppresses economic growth. On the other hand, less congestion provides faster and more reliable travel times, which improve productivity and reduce costs. Furthermore, correctly pricing a scarce resource (i.e., roadway capacity) leads to innovation and efficiencies that further boost economic competitiveness. Section 3.0 presents analytical methods that could be used in the next update to *Plan Bay Area* to analyze the economic impacts of cordon pricing, congestion pricing of parking, more aggressive congestion pricing of bridge tolls, and other mechanisms.

- **Goods Movement.** Nearly all industries, including professional services, rely on efficient movement of goods to support a cost-effective business environment, and to maintain affordability and quality of life for residents. In addition, businesses providing goods movement services provide relatively high-wage jobs for the lower-skilled segment of the Bay Area's workforce. Thus, economic analysis of goods movement investments and policies provides credible measurement of the region's likely retention of lower-skilled, middle-income employment in the region. Section 4.0 presents a framework and process for economic analysis that will enable MTC and ABAG to better estimate the impact of the RTP goods movement projects and SCS land use policies on Bay Area employment and output (i.e., GRP), and measure the cost effectiveness of these investments. The approach builds on MTC's 2004 and 2008 good movement studies, and will help MTC make the case for targeted transportation investments by better understanding their economic impact.
- **Housing Policy.** There are an estimated 116,000 workers who currently commute into the Bay Area from outside the region. This amounts to approximately 3.4 percent of the Bay Area's workforce. *Plan Bay Area* assumes that ratio of in-commuters will remain constant through 2040. This amount of in-commuting compares favorably to the year 2000, when just more than 10 percent of Bay Area jobs were filled by commuters living outside the region. Section 5.0 of this report describes how housing supply affects the economy and focuses in particular on the economic effects of locating housing closer to jobs. The section recommends applying a similar methodology used in *Plan Bay Area* to assess the economic impacts of policies that increase the housing supply overall, and especially in closer proximity to jobs.
- **Market Feasibility of PDAs.** This section describes how the next update to *Plan Bay Area* could further evaluate the market feasibility of PDAs. While this topic is not strictly about economic impact analysis, business community stakeholders have raised concerns about the significant amount of residential and employment growth allocated to the region's PDAs in *Plan Bay Area* and whether the PDAs can accommodate this growth. Along with the support of implementation funding and other policy tools, *Plan Bay Area* assumes the market and community support will be sufficient to absorb projected new development. As identified in the *Plan Bay Area* supplemental report -

Priority Development Area (PDA) Development Feasibility & Readiness Assessment – analysis of a sample of PDAs indicates that regulatory or community constraints may limit some of the assumed scale, mix, or density of development. The focus of Section 6.0 is on the methods, data, and tools needed to measure the sufficiency of market demand in PDAs, including those identified in the PDA Development Feasibility & Readiness Assessment.

Each topic described above is presented in its own section in the report, and each section follows a similar format. This format divides the topic into three parts: 1) an overview that describes how the topic impacts the regional economy; 2) descriptions of the most feasible analytic methods and tools used to assess the economic impacts; and 3) an assessment of MTC's or ABAG's readiness to conduct the preferred method of analysis, including access to sufficient data and analytic tools. Appendix A includes an annotated bibliography that summarizes relevant studies for each subject topic. The state of good repair, roadway pricing, and goods movement sections focus on investments and policies embedded in the RTP component of the next *Plan Bay Area* update and are presented first. Following these topics, housing policy and PDA feasibility would be most affected by policies embedded in the SCS component of the next Plan.

At the request of the business stakeholders, we have prepared a synopsis of the best practices of regional and state agencies across the nation that have applied economic impact analysis to evaluating the performance of their long-range transportation plans and project selection process. In Appendix B, we present examples of successful analytical methods, engagement practices, and performance-based planning by metropolitan planning organizations (MPO), state departments of transportation (DOT), or economic development corporations. These practices all share the goal of better understanding the impact of transportation investments and land use policies on state or regional economic growth.

1.4 RELATIONSHIP BETWEEN ECONOMIC IMPACT ANALYSIS FOR NEXT *PLAN BAY AREA* UPDATE AND OTHER BAY AREA STUDIES AND INITIATIVES

The context for the economic impact analysis includes many studies and initiatives intended to better understand the benefits and tradeoffs between transportation investments (e.g., project prioritization, SGR versus expansion), land use policies, and new revenue measures. Each of these, however, has a unique set of stakeholders who have specific objectives. While some are seeking an objective of understanding economic impacts, many are aligned to foster economic development.

Given other recently completed or economic-related studies underway, CS has evaluated the relationship of other research and policy initiatives prepared by

other agencies and private stakeholders that analyze or advocate for transportation investment and land use policy as a means of increasing the region's economic output and/or employment. In particular, two projects with a regional emphasis are highlighted below:

1. **Regional Prosperity Plan.** MTC and ABAG are currently undertaking a three-year initiative funded by a $5 million grant from the U.S. Department of Housing and Urban Development, in conjunction with the U.S. Environmental Protection Agency and the U.S. Department of Transportation. The project will identify strategies to improve the region's economic prosperity by encouraging stronger, more sustainable communities, integrating housing and jobs planning, fostering local innovation in support of new jobs, and building a healthy regional economy for all. Over $2 million in grants will be awarded to pilot projects to expand economic opportunities for low- and moderate-income workers and improve affordability near transit. The planning effort includes three elements: an economic opportunity strategy, a housing the workforce initiative, and an equity collaborative that, together, will implement this program. These efforts are not likely to recommend analytical methods for evaluating economic impacts.

2. **JPC Regional Economic Development and Resilience.** The JPC coordinates the planning efforts of ABAG, the Bay Area Air Quality Management District, the Bay Conservation Development Commission, and MTC. One of the JPC's current projects focuses on regional economic development. Through this focus and prepared at the request of the JPC, the Bay Area Council's Economic Institute completed the *Regional Economic Assessment of the San Francisco Bay Area Economy*, which provides comprehensive analysis about what drives the regional economy in terms of competitiveness, growth and jobs. It also identifies barriers to growing a stronger regional economy with additional jobs in the future. It concludes by highlighting a number of areas for attention that, together, could be developed into a regional economic development strategy. The recommendations are well supported with data-driven, rigorous analytical methods, but the goal is focused on economic development and not economic impacts.

2.0 Economic Impacts of Maintaining the Region's State of Good Repair (SGR)

This section presents a framework for measuring the regional economic effects of investments to maintain the Bay Area's transportation assets in a state of good repair (SGR). The following sections summarize the data, tools and methods needed for this analysis. Each analysis in the presented framework would result in a monetized value of direct economic impact that could be used in a regional economic model to estimate total (direct, indirect, and induced) economic impacts.

2.1 INTRODUCTION

As the assets of the Bay Area's existing transportation infrastructure continue to age, the impacts on quality and reliability of services and the costs of replacement and rehabilitation mount. The funding for maintaining a SGR competes with expanding transportation infrastructure to serve growing demand. Transportation funding largely comes from gas tax revenues, which are not indexed to inflation, and sales tax revenues; both of which have declined as a result of the recent economic recession. Over the long run, these sources, especially sales tax, are not indexed to the SGR needs, so even as the financial needs increase, the funding sources have declined or remained flat. The federal transportation reauthorization, Moving Ahead for Progress in the 21st Century Act (MAP 21), includes new performance-based programs to support maintenance of SGR and asset management, but the two-year extension does not increase the gas tax, or offer any other significant new funding[4].

MTC has long advocated a "fix it first" strategy that underscores the performance benefits and cost effectiveness of preventive maintenance on the regions' transit systems and roadways. Over the last several RTPs, MTC has invested over eighty percent of its funding on maintaining regional transportation's SGR.

[4] U.S. DOT Federal Transit Administration (FTA) "MAP-21 Tracker", http://fta.dot.gov/map21/, accessed July 19, 2012. Also see U.S. DOT FHWA, "Summary of Provisions", http://www.fhwa.dot.gov/map21/summaryinfo.cfm.

Table 2.1 illustrates SGR planned investments in the last three RTPs (Plan Bay Area, Transportation 2035 and Transportation 2030).

Table 2.1 Comparison of SGR Expenditures in MTC RTPs
(in Billions of Year of Expenditure Dollars)

RTP Year	Public Transit Operations & Maintenance	Roads & Bridges Operations & Maintenance	Total
2030	$61 (51%)	$36 (31%)	$97 (81%)
2035	$111 (51%)	$66 (30%)	$177 (81%)
2040	$164 (56%)	$93 (32%)	$257 (88%)

2.2 SUGGESTED FRAMEWORK FOR ECONOMIC ANALYSIS

The condition of transit and roadway assets affects regional economic growth by providing three types of direct benefit:

1. Lower costs for timely preventive maintenance, rehabilitation, and reconstruction versus more expensive cost for delayed rehabilitation or replacement,
2. Reduced nonrecurrent traveler delay caused by unscheduled outages of transit vehicles and closures of bridges or roadways, and
3. Lower vehicle operating costs because of less wear and tear.

The current state of good repair (or SGR) of the Bay Area's roadways, bridges, and transit infrastructure, has a direct effect on the productivity of the Bay Area's economy. If the current-level SGR degrades, the Bay Area's businesses and households will try to adapt. If the change in SGR is temporary and not too severe, chances are that the Bay Area's output (GRP), household income, and employment (all measures of economic performance) will not change significantly. If SGR degrades beyond this unknown threshold of adaptation, however, the regional economy will likely suffer as a result of traveler delay, reduced productivity for Bay Area businesses, and increased vehicle maintenance and operating costs. Current analytical methods are not reliable enough to predict the optimal level of SGR. Nevertheless, we can affirm that Bay Area's businesses compete based on their access to workers and their ability to ship and receive goods. We also can affirm that if significant parts of the roadway and transit infrastructure approach the end of their useful life, they must be rehabilitated and, in some cases, replaced to sustain the current level of economic competitiveness.

Each of the three types of economic effects is described below. The outcome of each of the economic analyses of these effects is the direct economic impact for

each travel mode, expressed as a monetary figure. The total impact from each of the three analyses can be summed to represent the total direct economic impact of changes in SGR. To express each direct effect as an impact on economic growth, the amounts would be input into an economic model to illustrate their effects on the regional economy, including indirect and induced economic effects. When performed for multiple scenarios, including a "base case" scenario, the results will provide an indication of how the economy may react to changes in maintenance of SGR. Table 2.2 presents the key categories, data sources, and modeling tools suggested to complete an economic analysis of SGR investments in the MTC region.

Table 2.2 Economic Analysis Framework Components and Requirements

Category	Data	Recommended Modeling Tools[a]
1. Costs for preventive maintenance versus major rehabilitation	• SGR investment scenarios • Discount rate (for Lifecycle Cost Analysis)	• Transit Economic Requirements Model (TERM) • Highway Economic Requirements System (HERS) • MTC StreetSaver • I/O model provides indirect and induced economic effects
2. Costs of Traveler Delay	• Asset age/condition from transit agencies • Roadway condition rating • Rates to correlate roadway condition rating and travel speed • Current vehicle hours of delay	• TERM • HERS • MTC StreetSaver • I/O model (for indirect and induced effects)
3. Vehicle Operating Costs (VOC)	• Roadway condition rating • Rates to correlate roadway condition rating to vehicle operating cost. • Vehicle miles traveled (VMT) or vehicle ownership	• MTC StreetSaver • HERS

[a] For a description of each of these modeling tools and data sources, please see Appendix A.

1. **Comparison of costs for preventive maintenance versus major rehabilitation.** This measure represents the additional costs that will accrue as maintenance on regional transportation assets is deferred. The difference from investing in the short term versus the long term accrues because deterioration of asset quality increases exponentially as asset age increases. The future costs of maintenance or replacement also will be greater due to monetary inflation. This analysis is typically addressed in life-cycle cost analysis (LCCA), which considers both near- and long-term costs of maintaining assets. In addition, a comprehensive accounting of full life-cycle costs would include traveler delays caused by episodic failures. The basic calculation can be represented by the following diagram.

   a. *Roadways and Bridges.* MTC's research has shown that the costs to repair pavement increase exponentially as asset age nears the end of its useful life, and that preventative maintenance can extend the useful life of the asset. This research indicates that spending $1.00 on timely maintenance to maintain SGR saves at least $5.00 to restore the same road once it requires major rehabilitation.[5] The American Association of State Highway and Transportation Officials (AASHTO) estimated that for major highways, every $1.00 of preventative maintenance spending avoids $6.00 to $14.00 required to rebuild a roadway.[6] The Highway Economic Requirements System for States (HERS-ST) is an asset management tool that is used by California DOT (Caltrans) and other state DOTs to estimate financial needs of major highways. Similarly, MTC's StreetSaver estimates financial needs of local streets and roads and recommends the most cost effective treatments given available resources. Both of these tools could be applied in the next RTP to estimate total costs of various maintenance schedules and rehabilitation strategies.

   b. *Transit.* Transit operators maintain asset management systems that track the age and condition of equipment, vehicles, and facilities. By correlating asset age or quality to travel delay and changes in customer behavior (changes in ridership), it is possible to estimate the economic impacts of maintaining SGR versus different investment levels. A recent report for the Bay Area Rapid Transit District (BART) indicated that investing at one-half the funds needed to maintain SGR would result in a

[5] MTC, 2011, *Pothole Report,* Oakland, California, http://www.mtc.ca.gov/library/pothole_report/Pothole_Report_2011.pdf.

[6] AASHTO and TRIP, 2009, *Rough Roads Ahead, Fix Them Now or Pay for it Later*, Washington, D.C., http://roughroads.transportation.org/RoughRoads_FullReport.pdf.

loss of $22 billion to the regional economy, due to travel delay and loss of ridership (see Appendix A for a summary of BART's recent "A State of Good Repair for BART: Regional Impacts Study"). National research and economic analysis tools, such as the FTA's TERM, also support BART's findings. Given the range of different transit services in the Bay Area, MTC would need to tailor the analysis to maintain consistent assumptions (e.g., asset condition versus age, asset types), such that results are comparable.

2. **Traveler delay.** Public transit asset conditions are generally understood to affect the average travel speeds of transit vehicles due to greater vehicle breakdowns and slower vehicle operating speeds due to safety constraints. This results in greater user delays, typically the largest component of economic impacts of transportation investment analysis.[7,8] Road conditions may also have marginal impacts on road vehicle operating speeds[9], although vehicle operating costs are generally recognized as the most significant impact (as discussed in the following section). MTC is currently developing a new approach to integrate road and transit asset conditions directly into the regional travel demand model, allowing for consistent analysis of expansion and maintenance projects alike. New methodologies and data sources are required to estimate the effects of state of good repair investments on regional performance.

   a. *Roadways and bridges*. MTC measures regional travel delay on freeways, arterials, and some local roads using the MTC travel model. Outputs include recurring delay (e.g., peak-hour congestion) and nonrecurring delay (e.g., crashes or other incidents). In addition, MTC uses the pavement management software system StreetSaver to estimate the costs of maintaining (or not) SGR. StreetSaver uses the pavement condition index (PCI), which is a value from 1 to 100, to represent the pavement quality based on observed physical attributes of the roadway.

      At this time, MTC has not identified sufficient empirical evidence demonstrating a strong correlation between road surface quality and observed vehicle speeds.[10] Potential sources for further evaluation

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[7] MTC, 2012, *Transportation Project Performance Assessment Revised Results*, Appendix B, Revised Benefit Cost Assessment: Detailed Materials.

[8] Noland, R. B., and K. A. Small, 1995, *Travel Time Uncertainty, Departure Time Choice and the Cost of Morning Commutes*, Transportation Research Record, 1493, 150-158.

[9] MTC, 2011, *Pothole Report*.

[10] Asset condition is implicitly included in the model, as it is based on observed travel data, which includes travel under historical roadway maintenance conditions. Staff at MTC are exploring ways to integrate the travel demand model and StreetSaver.

include HERS, a highway asset management tool developed for FHWA.[11] Additional data will be necessary to quantify the benefits for vehicle speed, if the relationship is proven to be significant.

b. *Transit*. Two types of direct impacts will affect transit riders as the transit infrastructure ages: If aging vehicles, track, control equipment, and other equipment are not maintained, refurbished, and replaced, the number of breakdowns or other asset failure will cause nonrecurrent delays. This delay can be represented as increased user travel time and/or reduced reliability (i.e., nonrecurrent delay). In addition, decreased reliability and unpleasant conditions (e.g., noise, system cleanliness, elevator/escalator breakdowns, etc.) will reduce ridership as users switch to other travel modes (which, in turn, increases roadway congestion). MTC is working to incorporate these impacts by tying the regional transit asset condition model, TERM-Lite, to travel time delays for various transit systems in the travel demand model. This will allow for a comprehensive look at how transit travel time delays resulting from asset conditions might affect key regional issues such as traffic congestion, out-of-pocket travel costs, and emissions.

   Few of the Bay Area's transit operators have implemented asset management tools that would help estimate the effects of SGR investments.[12] Nevertheless, BART has conducted some sketch-level analysis (using the TERM model) which has helped to inform MTC's current initiative to estimate benefits of system maintenance.

   Analysis recently conducted for BART on transit SGR relates transit asset age to breakdown rates.[13] The analysis was based on past studies completed in New York City, Philadelphia, and Chicago to relate asset age to measures of transit performance, such as percent on-time service for customers and trains, average time between rail car failure, rail car availability, elevator availability, and automated fare card availability. These measures were then correlated with average vehicle speeds, and ultimately traveler delay. The study noted that service speed is a function of crowdedness, which will increase due to having fewer vehicles in good repair. Crowded platforms and trains will slow service

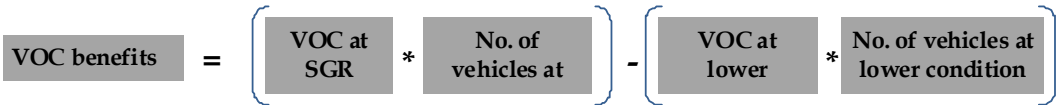
[11] U.S. DOT FHWA, 2005, *Highway Economic Requirements System – State Version Technical Report*, Washington, D.C., http://www.fhwa.dot.gov/ asset/hersst/ pubs/tech/ TechnicalReport.pdf.

[12] FTA, 2008, *Transit State of Good Repair: Beginning the Dialogue*, Washington, D.C., http://www.fta.dot.gov/documents/SGR.pdf.

[13] Deakin, E., et al., 2012, *A State of Good Repair for BART: Regional Impacts Study*, University of California, Berkeley.

due to increased boarding and alighting times. The specific results of this study are presented in Appendix A.

3. **Vehicle Operating Costs (VOC).** These are user costs associated with automobile and truck travel. Driving on rough roads accelerates vehicle depreciation, reduces fuel efficiency, and causes wear and tear to tires and vehicle suspension systems. Vehicle operating costs have been shown to increase as roadway conditions worsen.[14] A basic calculation for estimating changes in VOC can be represented by the following diagram:



   a. *Roadways and Bridges*. Data regarding personal vehicle operating costs (maintenance, fuel, tires, fees) is included in the MTC travel demand model. These operating costs can increase as the roughness of roadways and bridges increases by increasing wear on the vehicle. As discussed under item 2 above, MTC is in the process of developing a model-based state of good repair analysis framework. For highway, arterial, and local street maintenance, the primary benefits are expected to be a result of vehicle operating cost savings. Using national and international research sources, VOC impacts can be estimated for different vehicle classes based on the future forecasted International Roughness Index (IRI) levels of roadways. By using the regional travel demand model, this represents an opportunity to examine the range of behavioral impacts of smoother roads (in addition to the direct VOC savings). The integration of StreetSaver data into the travel model network is an important step towards examining state of good repair impacts on a level playing field with the impacts resulting from expansion investments.

   b. *Transit*. Vehicle operating costs do not apply to transit users, as they are not directly (out-of-pocket costs) associated with transit asset quality, although roadway surface quality may affect the total annual operating costs for regional transit agencies due to greater wear and tear on vehicles. See "Other Categories" below for other transit measures that may be developed.

Other Categories of Economic Analysis Considered

The economic effects of maintaining SGR extend beyond the three categories of direct impacts discussed above. However, the categories that can be assessed are limited to these three, given the availability of data and analytical tools. Other categories of benefits that do not have available data include effects of SGR on

[14]For example, see TRIP, 2009, *Mobility in California*, accessed July 16, 2012, at http://tripnet.org/docs/California_Mobility_Report_Dec_2009.pdf.

safety (crashes or other incidents), and the effect of transit station quality on transit ridership.

3.0 Regional Economic Impacts of Roadway Pricing

3.1 INTRODUCTION

This section presents a framework for measuring the regional economic effects of pricing on the Bay Area regional economy, and provides recommendations on how the next update to *Plan Bay Area* can evaluate the economic effects of pricing strategies. With only a few recent exceptions, the vast majority of U.S. motorists pay for driving through fuel taxes, sales taxes, and fixed vehicle charges, such as vehicle registration. Only the fuel tax has any correspondence to VMT, but has almost no variation according to where and when those miles are driven. This approach to pricing and funding transportation, therefore, charges what economists call the average cost, instead of marginal cost for driving. Average cost pricing fails to send a price signal to a driver that corresponds to the true cost of their behavior.

Congestion pricing is an application of marginal cost pricing to transportation, because it would charge users for the true cost of their activity. Congestion pricing imposes marginal costs on drivers based on where and when they drive, which will have both short- and long-term effects on travel behavior. Congestion pricing strategies are designed to increase the marginal cost per mile driven to a level that causes those most sensitive to the higher price to switch to nonpriced modes, lower priced (and less congested) hours or routes, or to reduce travel overall. This axiom of economic theory posits that the closer the marginal cost of a good or service is priced to its marginal benefit to the user, the more it will be produced and consumed with maximum economic efficiency.

Not only has economic theory long settled that marginal cost pricing of a scare resource ensures that the available capacity is used most efficiently, it also posits that additional capacity will be added only when the investment produces more economic benefit than spending the money on the next best alternative (i.e., opportunity cost). This attribute of congestion pricing ensures that operational improvements to existing roadways and transit infrastructure, and – depending on the aggressiveness of the congestion pricing policy – more efficient land use, are applied before additional investments in roadway and transit capacity are made.

The following sections present a methodology for the next update to *Plan Bay Area* that focuses on the impacts of roadway pricing on business retention, expansion, and attraction. An analysis of these concerns will illuminate how the region's economy will perform with and without pricing transportation policies.

- Section 3.2 presents a two-part framework for measuring the impact of roadway pricing schemes on the regional economy. The first part refers to recently implemented projects in the Bay Area that have quantified the economic effects of varying forms of pricing strategies. For studies with historical precedence, we recommend applying a regression-based econometric analysis. The second part describes a method for conducting an economic analysis of a structural change to the economy using an economic I/O model. The combination of these methods provides an understanding of the scope and magnitude on the regional economy of implementing different types of pricing schemes, and whether there are resulting generative or redistributive effects.
- Section 3.3 assesses MTC's technical readiness to analyze the economic impacts of pricing policies in the Bay Area. This includes the availability of methods, analytic tools, and data necessary for future economic analysis of updates to *Plan Bay Area*.

3.2 ECONOMIC ANALYSIS OF TRANSPORTATION PRICING POLICIES

Pricing strategies are designed to impose variable costs on drivers based on where and when they drive. Specifically, pricing strategies are intended to reduce congestion by motivating drivers to take fewer trips, shorter trips, use alternative modes, and shift travel to periods of lower congestion. The short-term effects on travel behavior of pricing strategies will depend on the alternatives available to travelers (alternative modes, destinations, etc.) and their sensitivity to price, which will vary by income, personal and household characteristics, and characteristics of the specific trip. The long-term effects will move beyond travel behavior adjustments to household choices about home and job locations, and employer decisions about expansion and relocation.

Pricing strategies that can be implemented at a regional level include:

- Facility-specific tolls, which would likely involve bridges, but could include tolling at major roadway portals;
- Parking pricing in congested downtown centers and around BART stations, which would have a similar effect as facility-specific tolls, but may have a greater effect on localized mode choice behavior;
- Open road congestion pricing, which prices roadway facilities when they are congested in order to reduce traffic on those segments and maximize throughput; and
- Cordon/area pricing, which applies a fee for vehicles to enter or operate within a selected area, such as a central business district (CBD).

In the Bay Area, two methods are currently being used to measure the economic effects of pricing strategies (Econometric Analysis and Economic Simulation), and are summarized in Table 3.1. The table presents data sources and modeling tools. These methods focus primarily on the travel behavior outcomes, with less emphasis on the effects on the regional economy. Nevertheless, we can increase our understanding of potential regional economic outcomes by summarizing some of the relevant research that has been completed to date.

Table 3.1 Methods to Measure the Economic Effects of Pricing in the Bay Area

Method	Approach Highlights	Data Requirements/ Tools Needed
Econometric Analysis of Pricing Strategies Using Historical Before and After Data	Uses a regression model to understand the changes in travel/economic outcomes.	• Regression model
Economic Simulation of Pricing Strategies using an I/O Model	Takes outputs from the MTC travel model and translates them into economic outcomes. Although the outcomes are heavily reliant on input assumptions within the travel model, the advantage of this analysis includes the ability to see the effect sector-by-sector and across different geographic and demographic strata.	• MTC travel model • Economic model (e.g., IMPLAN, REMI, or TREDIS)

At the most basic level, economists can measure sensitivity to pricing strategies with before and after travel data using an econometric, or regression model.[15] A regression model would correlate some measure of economic benefit (e.g., GRP, employment, household incomes, etc.) to the level of congestion pricing, changes in travel behavior, and household demographic characteristics (e.g., gender, age, and education). In a study conducted through the University of California (UC), Berkeley on Bay Bridge toll evaluation, researchers estimated regression equations, which estimated the influence of peak-period toll charges on traffic volumes. These models controlled for other factors that could explain variation in demand, such as rising gasoline prices and unemployment levels in the region. The research then developed separate predictive models for explaining changes in peak-period traffic on HOV lanes (i.e., carpools, motorcycles, and qualified low-emission vehicles), as well as total monthly traffic (i.e., all lanes, peak and

[15] A regression model is an equation with a dependent variable (e.g., GDP, personal income, etc.) on the left-hand side and a set of independent variables (e.g., an explanatory variable and key control variables, such as vehicle hours of delay, roadway capacity, transit service, land use density, incomes, car ownership, etc.) on the right-hand side of the equation.

off-peak weekdays plus weekends). Examples of these models, including the dependent and independent variables are provided in Appendix C.

Economic simulation measures to what degree pricing strategies cause a structural change to the regional economy. This approach takes the results of an analysis by the MTC travel model of the direct impacts of pricing strategies on network performance and travel behavior, and measures their effect on each industry sector's employment – or output county-by-county – and household income strata. The most common measures of roadway network performance include changes to speeds, person and vehicular throughput, travel time, and intersection queue lengths. Transit performance is measured with transit end-to-end trip times, transit headways, transit patronage, farebox revenue, mode splits, and the temporal changes in traffic patterns.

These direct impacts on transportation performance are converted to monetary equivalents (monetized) and input into an economic model, such as an I/O model (e.g., RIMS, IMPLAN/TREDIS) or dynamic equilibrium model (e.g., REMI). These models isolate the economic impacts of each type of pricing policy at a county level, or may be aggregated to a regional level. The impacts are expressed as differences between a base case scenario (i.e., a no-project or business-as-usual that have no pricing strategy), and one or more scenarios that have different congestion pricing strategies and/or pricing amounts.

The impacts to the Bay Area economy are not necessarily directly proportional to the savings in travel times and improved reliability. The amount of economic impact between a no-pricing base case and different pricing scenarios depends on two sets of conditions. The first condition involves the level of pricing needed to change behavior and reduce congestion on specific corridors and roadways in the network. Some congested corridors have readily available and well-functioning transit alternatives, or workable underutilized alternative routes, while others do not. For those that do not, higher pricing levels are needed to divert drivers to off-peak time periods. This could potentially cause economic disbenefit because workers may not arrive to work in the time most economically viable for them (e.g., at 8:00 a.m. when a worker's shift starts); and deliveries may not arrive at the time most economically maximizing (e.g., 6:00 p.m. before the cut-off for next day delivery). The higher toll or other pricing mechanism will divert spending from personal consumption in the case of commuters or shoppers, and increase business costs for firms paying for on-the-clock travel.

The second condition involves how each of the four types of trip purposes is affected by a pricing policy: on-the-clock, commute, shop, and social/leisure.

1. **On-the-clock travel.** Congestion, and especially nonrecurring congestion (i.e., not regularly occurring congestion, such as those stemming from crashes, disabled vehicles, work zones, adverse weather events, and planned special events), has the most significant economic consequences to on-the-clock travel. These business trips are most often truck trips moving goods

from shippers to receivers (see Section 4.0 on Good Movement for a detailed description of this impact).

2. **Commute Trips.** The next most economically significant impact of delay involves commute trips (see Section 6.0 on Housing Policy and Access to Labor). Reducing delay for commuters may lower wage demands and improve an employer's access to a larger and more diverse labor pool, but pricing strategies offset these benefits by raising household cost.

3. **Shopping Trips.** The economic impacts of tolling shopping trips may present the most complex analytical challenge. Conventional wisdom posits that pricing access to retail centers will divert shoppers to retail locations that do not require payment of a toll to access. The potential effects on retail sales inside a cordon or parking pricing zone, however, may have more misperceptions and unexpected impacts than other economic impacts of congestion pricing. This topic was a significant concern before and after London implemented cordon pricing, and had a major role in the decision not to proceed with cordon tolling programs in Edinburgh and New York.

   Much of the opposition to congestion pricing in city centers has been predicated on the simple assumption that increasing the cost of access to downtown stores and restaurants will drive away business. However, retail sales may be driven by a subset of motivated shoppers, while a remaining and significant proportion of all retail traffic is merely looking, but purchasing very little merchandise. Furthermore, these "big-spenders" may not be deterred if required to pay more for parking, and may be more likely to travel if their access by auto were less congested. At this juncture, it is difficult to identify these segments, how much they spend when they shop and dine, and how their behavior will change under congestion pricing.

   The existing research on the potential and actual impacts on the retail sector includes the following studies related to cordon pricing program imposed on downtown London. A report commissioned by John Lewis (a large department store chain in England) postulated that cordon pricing had reduced their revenues by up to 10 percent. Transport for London (TfL) commissioned a study that showed that revenues may have gone down slightly, but this was due to the general downturn in London's economy at the time that cordon pricing was introduced. Following this study, TfL issued rigorous yearly audits that revealed little or no effect on revenues, and provided some evidence that retail sales and entertainment spending at higher-end establishments have increased because of cordon pricing.

4. **Leisure and Social Trips.** Finally, pricing of leisure and social trips should have limited, if any, adverse economic impact. The exception would be trips that involve tourism, dining out, or entertainment. If congestion pricing curtailed these activities, the lower spending would reduce economic activity. To the degree that these trips involve visiting friend and family, the

economic consequence of charging a traveler a toll or diverting them to travel at less congested times, routes, or modes would be minimal.

A critical consideration of any evaluation of pricing strategies, therefore, will be to understand the distribution of benefits and costs of the system among users. This will necessitate analysts to disaggregate the journey purposes defined within the existing travel model segmentation to ensure we can predict the impacts and measure the benefits to different trip purposes.

Finally, MTC should consider four additional categories of economic impacts, which will require a mix of qualitative and quantitative analysis methods. These are short-term business impacts, environmental impacts, social impacts, and wider economic impacts.

1. **Short-Term Business Impacts.** During both the failed attempt to adopt New York City congestion pricing, and before the successfully implemented London cordon pricing scheme, businesses within the priced zone were very concerned about the short-term impacts on their business. The New York City Council countered this concern by calculating the impacts of excess congestion across industry sectors, and describing how the pricing scheme could reduce overall congestion, ultimately affecting $2.4 billion in revenue and 12,000 jobs annually. The sectors most affected were construction, manufacturing, and other businesses that require on-time deliveries.

   A San Francisco County Transportation Authority pricing study included a scenario analysis on the impacts of business activity due to an areawide cordon pricing scheme. The study estimated changes in business activity across the Bay Area region using a business activity relocation model linking accessibility to business activity by sector based on businesses' service orientation, output market power, labor dependency, and the sensitivity that businesses might relocate outside of San Francisco in response to a change in relative transportation costs and accessibility. The initial results indicated a possible negative employment impact within San Francisco of up to two percent, with the repositioning of some business activity in the region. The overall finding, however, is that business and employment impacts would be broadly neutral to positive. This is because spending and output would increase substantially because of two reasons. First, based on a retail spending analysis, current monthly spending by transit users and pedestrians in the downtown area is comparable to or exceeds monthly spending by automobile travelers due to the increased frequency of transit and walk trips, meaning increased economic output for the businesses within the pricing zone. Second, the positive employment impact of an initial external investment of $60 million to $100 million to implement the congestion pricing system would be significant (e.g., construction), mitigating the business impacts within the pricing zone.

   Actual before-and-after data were evaluated for the London cordon pricing scheme. In that case, based on an annual survey conducted in 2005, results

showed that while businesses throughout central London performed well, businesses in the charging zone outperformed those outside. This analysis confirms why a majority of businesses continue to support the charge, provided that there is continued investment in public transportation. For the Bay Area, the short-term business impacts need to be assessed on a regionwide level, and the burden of any economic impact needs to offset with how and where the excess revenue from the pricing strategy is spent to benefit alternative modes of access, offset adverse business impacts, or improve environmental quality benefiting the region as a whole.

2. **Environmental impacts.** Economic impacts are affected by how congestion pricing affects climate change and environmental impacts. The latter are derived in part from the vehicle operating cost changes around fuel consumption that are measured as part of the economic appraisal. Such measures include noxious emissions (NO_x, particulates, SO_2) and CO_2. The environmental impacts assessment also can evaluate - at a high level - the exposure to noxious emissions derived from traffic volumes. These evaluations can identify how air emissions vary not only by alternative, but also by location. This allows the distribution of environmental impacts to be assessed not only for residents, but also for pedestrians, cyclists, and road users. All of these impacts can be monetized and fed into an economic analysis. The state of the practice for this monetization process is improving, but we regard current methods for evaluating some environmental impacts described above as in need of more refinement before they are fully integrated into a quantitative economic analysis.

3. **Social impacts.** A range of different social impacts can be assessed; some of which are readily quantifiable, and others which must be expressed in qualitative terms. The quantitative impacts include safety, where we can readily measure the effects that pricing strategies have on rates and severity of accidents. Accessibility may be measured both qualitatively and quantitatively. Pricing will affect accessibility differently for different modes. It is likely that there will be tradeoffs for private motorists with easier access due to lower congestion, but higher costs to that access. For transit users, cyclists, and pedestrians, lower traffic volumes tend to enhance access. In addition, these modes are likely to benefit if the excess revenues are spent to improve transit, bicycle, and pedestrian facilities and services. To the degree that these impacts can be measured and their direct benefits and cost monetized, they can be incorporated into an economic analysis. The same accommodation is possible for the effects of pricing on personal health measures. MTC's performance measure assessment for *Plan Bay Area* included measures for the average time walking or biking per person, which were translated into health outcomes and monetized.

4. **Wider Economic Impacts.** The core economic impacts from pricing strategies are derived from reducing congestion and operating costs for road users, and improved conditions for other transport users. Nevertheless, there

are wider economic impacts that are difficult to take into account adequately by conventional economic methods. These include the long-term effects on business (e.g., retail demand within and outside charged areas and times, effects on ability to access labor); impact on agglomeration (whether reduced congestion and charges increase or decrease the appeal of a business district for businesses that benefit from being co-located with other businesses); and impacts on regeneration/revival of deprived areas. Appraisal of these impacts tend to be undertaken on a strategic and qualitative basis, but will be critical in informing discussions about location, timeframes, prices, and the overall value of any pricing strategy or charging system.

3.3 TECHNICAL READINESS FOR THE ECONOMIC ANALYSIS OF PRICING

MTC already has most of the tools needed to evaluate pricing on the Bay Area economy. In fact, the travel model already incorporates a number of ways to measure the effects of pricing on travel behavior, and has already done so for previous RTPs. We are reasonably confident that MTC has essential data and the necessary analytical tools to conduct a regional economic analysis of congestion pricing strategies.

In the next update to *Plan Bay Area*, we recommend systematic and comprehensive quantitative analysis to determine the economic impact of pricing strategies on the regional economy. At a minimum, potential congestion pricing strategies should include increased congestion pricing for tolls on bridges, three-plus HOV policies on saturated segments of the proposed express lane network, open road tolling on the most congested corridors, and targeted variable pricing for parking. BART is currently considering some introduction of variable pricing to its paid parking program at select BART stations.[16] Although the travel model is not sensitive enough to model the unique costs for parking at individual BART stations and how that might affect local individual mode choice behavior, an econometric analysis could assess its impacts on travel behavior.

The outputs from the travel demand model may be fed into a regional economic model to evaluate the impact of pricing strategies on different industry sector and households. The refinement of some econometric methods could provide further insight on how a pricing strategy impacts different types of users by income or socioeconomic classification due to expanded or restricted travel options or costs for certain segments of the population. A separate analysis on goods movement activity could be modeled with a truck model developed for SCAG and a REMI economic model (See Section 4.0, Economic Impacts Related to Efficient Goods Movement).

[16] http://www.bart.gov/guide/parking/index.aspx.

4.0 Economic Impacts Related to Efficient Goods Movement

4.1 INTRODUCTION

Economic analysis of public sector investments and policies is important at all times, but is especially important given the region's objectives to retain middle-income employment in the region.[17] Nearly all industries, including professional services, rely on efficient movement of goods to support cost-effective business environment, and to maintain affordability and quality of life for residents. In addition, businesses providing goods movement services provide relatively high-wage jobs for the lower-skilled segment of the Bay Area's workforce.

This section presents a framework and process for economic analysis that will enable MTC and ABAG to better estimate the impact of RTP goods movement projects and SCS land use policies on Bay Area employment and output (i.e., GRP), and measure the cost effectiveness of these investments. The approach builds on MTC's 2004 and 2008 good movement studies and could help make the case for targeted transportation investments by better understanding their economic impact.

- Section 4.2 presents the recommended framework for analyzing the economic effects of transportation improvements and land use policies. It describes how the effects of transportation improvements can be traced through industry supply chains to more accurately estimate the economic impact of transportation improvements on industries and the region's economy.
- Section 4.3 describes the technical resources – data, analytical tools, etc. – that MTC and ABAG will need to update or acquire to analyze the economic impacts of goods movement on the Bay Area economy. The section recommends that MTC consider refreshing the 2004 regional goods movement study to provide a solid foundation for assessing the economic impacts of current proposed transportation improvements.

[17] ABAG, May 2012, Jobs-Housing Connection Strategy, San Francisco, California.

4.2 ECONOMIC ANALYSIS OF GOODS MOVEMENT ON THE REGIONAL ECONOMY

Goods movement underpins and enables almost all economic activity. The flows of truck, rail, water, and air shipments of materials, parts, and finished products are almost as diverse and complex as the economy they serve. The next sections 1) recommend a framework for understanding goods movement; 2) provide a brief example of how to use the framework to describe an industry, its supply chain, and its freight flows; and 3) outline the analytical steps needed to assess the economic impact of transportation improvements on supply chains, industries, and a regional economy.

Framework for Describing Goods Movement

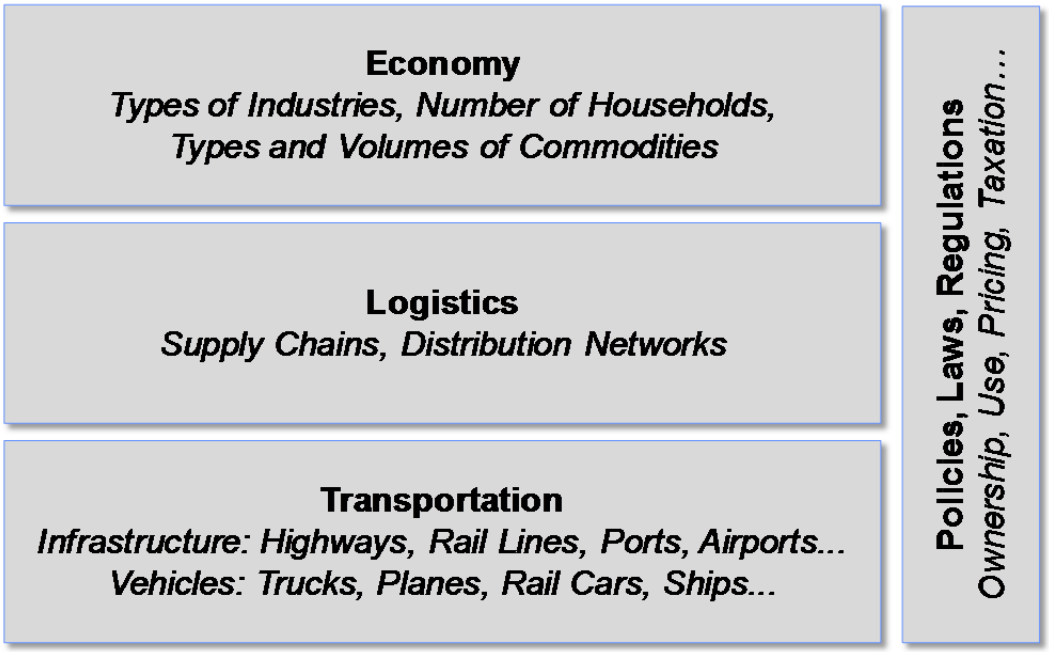
A key first step in assessing the impact of transportation improvements on the economy is to differentiate good movement patterns by industry. This makes it possible to trace the effects of transportation improvements and land use policies to specific industry sectors, which leads to better estimates of economic impacts. Figure 4.1 shows the following four major elements of the freight transportation system:

1. **Economy.** The economic structure of the Bay Area – the types of industries and the number of households – determines the types and volumes of commodities that are moved in the region. An understanding of the economic sectors that generate demand for goods movement in the region – how they contribute to the regional economy and their growth prospects – is a critical building block to assessing economic impacts. At the most basic level, it sets the stage to answer the question: Is a transportation improvement supporting an industry that is growing, stable, or declining?

2. **Logistics.** Logistics describes where industries source, make, stage, and sell their materials, parts, and finished products – the activities and links that make up their supply chains and distribution networks. Firms within an industry generally have similar logistics strategies and supply chains, but there is great variation across industries. As a consequence, transportation investments and land use regulations can have radically different economic impacts from industry to industry. Depending on the location of the transportation project, investments also can have different impacts on firms within an industry.

   Understanding the logistics strategies and the physical supply chains and distribution networks of industries in a region provides the information needed to trace the effect of transportation improvements to the economic performance and competitiveness of specific industries. Knowledge of logistics strategies and supply chains also helps identify transportation improvements that are needed to support specific industries.

Figure 4.1 Elements of Freight Transportation System



3. **Transportation.** The transportation element has two major components:

   a. *Infrastructure.* For goods movement, infrastructure comprises road, rail, water, air and telecommunication networks, truck and rail terminals, ports and airports, customs stations, distribution centers, etc. – all the physical facilities that enable industries and their freight carriers to move goods and execute their logistics strategies; and

   b. *Commodity and vehicle flows.* Commodity and vehicle flows over roads and rail lines and through ports and distribution centers represent the execution of industry supply chains using the available freight transportation infrastructure and services.

   Businesses and their carriers adjust their commodity and vehicle flows to make best use of the existing transportation infrastructure. When they cannot do so cost effectively, they change their logistics strategies – buying from different suppliers, routing shipments by different modes and carriers, and shrinking or expanding market areas. If these changes fall short, firms may then look to restructure or relocate their business. All of these changes may result in significant economic impacts for an industry and the economy of a region.

4. **Laws.** The final element of the freight transportation system recognizes that goods movement operates within a framework of institutional and commercial relationships governed by statutes, regulations, standards, policies, and established practices and customs. This regulatory framework shapes and controls economic activity, logistics practices, and the

transportation system. Changes in the regulatory framework can have effects that are as (or more) far-reaching than transportation capital and operating changes. An example is the economic deregulation of the freight transportation industry in the 1980s through the Stagger's Act, which deregulated the rail industry, and the Motor Carrier Act of 1980, which deregulated the for-hire trucking industry. The economic deregulation of the freight transportation sector led to a massive restructuring of the freight transportation industry and its services. Attention to legal and regulatory issues also is important in assessing economic impact, because legal and regulatory actions can either reinforce or negate the benefits of transportation investments.

The framework illustrated in Figure 4.1 can be used to profile goods movement for a broad industry sector or a very specific subsector. The North American Industry Classification System (NAICS), the standard used by federal agencies and economic analysts in classifying business establishments, identifies 20 general industrial sectors and hundreds industry subsectors.[18] Analysis can be done at a sector or subsector level. Likewise, logistics patterns can be described at the industry level or the firm level, and parsed by inbound and outbound flows, international and domestic flows, etc. The transportation infrastructure can be described by mode (highway, rail, etc.) or by trade corridor served by several modes. Finally, commodity and vehicle flows can be broken down in considerable detail. The U.S. DOT's Freight Analysis Framework (FAF), as an example, describes freight flows by 44 commodity types, eight transportation modes, 123 domestic origin and destination regions, 50 states, and eight international regions.[19]

Using the Framework to Describe an Industry and the Industry's Supply Chains and Freight Flows

Using the framework, a description of goods movement for an industry – big box retailing, for example – might start as follows:

- **Big Box Retailing and the Bay Area Economy.** The economic health and competitiveness of the retailing industry are important to the whole Bay Area economy. Retail goods movement covers distribution of food, clothing, and consumer goods, and the provision of a wide range of household and office materials and furnishings. Retailing in the Bay Area contributed $16 billion toward the $326 billion GDP of the Bay Area metropolitan statistical area (MSA) in 2010, but generated upwards of 20 percent of the freight tonnage

[18] See http://www.census.gov/eos/www/naics/.

[19] See http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/faf3/userguide/index.htm#t1.

moved in the region.[20,21,22] While the retail sector accounts for only 5 percent of the overall Bay Area GDP, it directly supports the private, service-providing industries that dominate the Bay Area economy. As shown in Table 4.1, private-sector, service-providing industries account for approximately three-quarters of the regional GDP. Labor costs are critical to the competitiveness and growth of service-providing industries, which depend on highly skilled, and therefore highly mobile, labor. The efficient movement of retail goods helps keep the cost of living down for service industry employees, which, in turn, helps keep the cost of doing business down for service-providing businesses. In this way, transportation investments in goods movement keep key Bay Area industries competitive with other national and international economic regions.

Table 4.1 Bay Area MSA Industry Sectors and GDP, 2010

Bay Area MSA Industry Sectors	2010 GDP (in Billions)	Share
Metro area total	$326	
Private industries	$297	91%
Private services-providing industries	$243	75%
Financial activities	$79	24%
Professional and business services	$61	19%
Private goods-producing industries	$54	17%
Wholesale trade	$13	4%
Retail trade	$16	5%
Education and health services	$23	7%
Government	$29	9%
Transportation and utilities	$14	4%
Leisure and hospitality	$12	4%

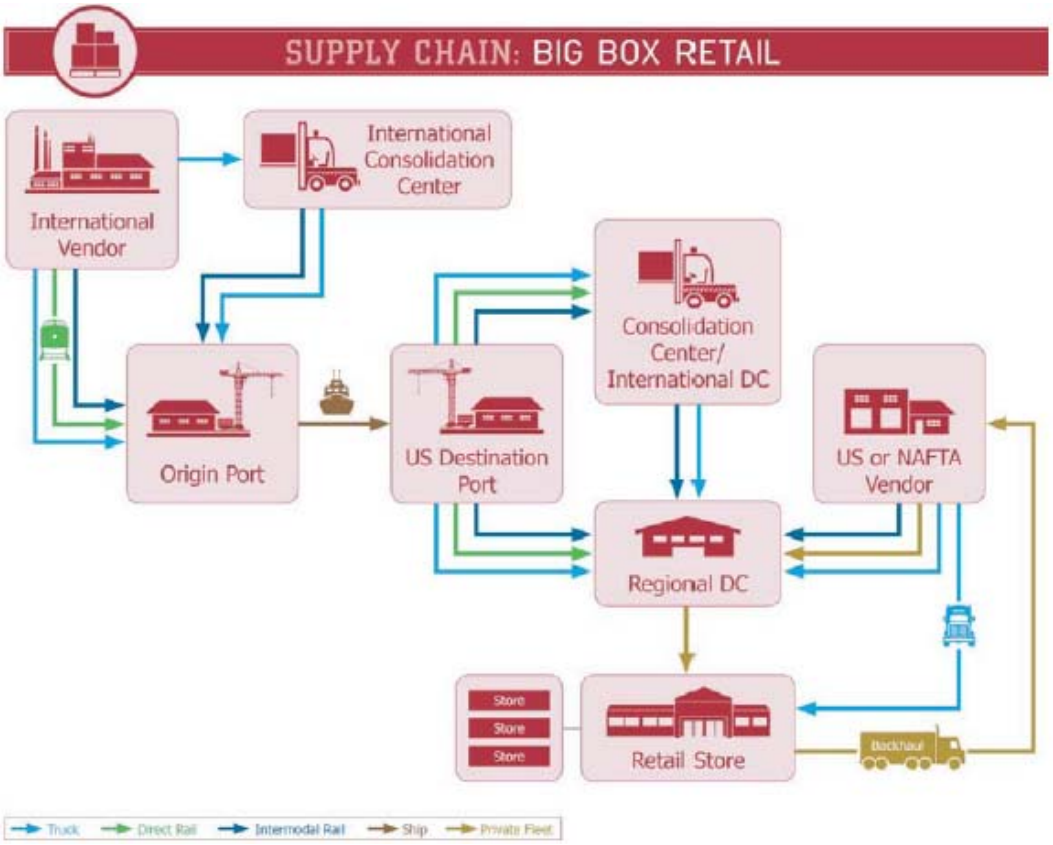
[20] Bureau of Economic Analysis, Regional GDP and Personal Income Tables for the San Francisco-Oakland-Fremont (California) MSA, 2010 data, http://www.bea.gov/iTable/iTable.cfm?ReqID=70&step=1.

[21] GRP (and its national equivalent, (GDP)) is a measure of valued added in the production and delivery of all goods and services.

[22] Approximated from data in the *Regional Goods Movement Study for the San Francisco Bay Area: Final Summary Report*, MTC, December 2004.

- **Big Box Retailing Supply Chain.** Figure 4.2 is a schematic map of the supply chain for the big box retailing industry and its associated upstream wholesalers and suppliers. The supply chain map is highly simplified, but is generally representative of the supply chain structure of the dozen or so big box retailers in the Bay Area. Each node and link in the supply chain has a cost and benefit to the industry. Transportation improvements that reduce costs and improve the performance of the big box retail supply chain will benefit the Bay Area economy. Improvements in the RTP will focus on the nodes and links in the immediate Bay Area, but it is important to understand the overall structure of the supply chain. An investment in the Bay Area may or may not produce an overall improvement to the benefit of the Bay Area economy. Depending on the scale of the investment or policy, an economic impact analysis might encompass all the regional nodes and links, or focus more closely on goods movement into and out of regional distribution centers (DC) and retail stores.

Figure 4.2 Schematic of the Big Box Retail Industry Supply Chain



Source: *Guidebook for Understanding Urban Goods Movement,* National Cooperative Freight Research Program (NCFRP) Report 14, Transportation Research Board, Washington, D.C. PDF available at http://www.trb.org/Main/Blurbs/ 166828.aspx.

- **Transportation.** Mapping the big box retailing industry's supply chains against the actual location of the port terminals, regional DCs and key retail stores in the Bay Area would reveal the freight facilities, roads, and rail lines that are critical to this industry. From there, the next step is to look at the actual truck and rail flows and match them to known congestion and capacity problems. This sets the stage, first, for determining whether a project would improve the truck or rail flows, and then second, determining whether those improved flows make a significant difference for the industry and economic performance in the Bay Area. If a proposed transportation improvement is not on a route that serves nodes and links that are important to the industry, then the improvement may not be a cost-effective investment for the Bay Area economy.

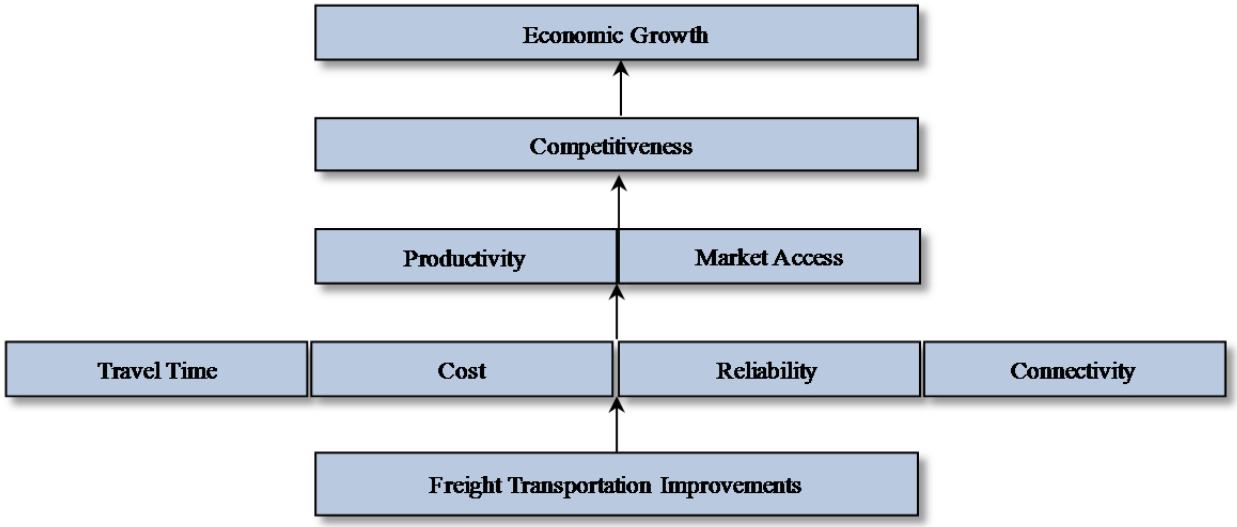
Using the Framework to Analyze Economic Impacts

The common practice in assessing the economic impact of transportation improvements is to assess only the transportation and economic impacts – the top and bottom boxes in Figure 4.1 – skipping over consideration of the effects of the transportation improvement on industry logistic strategies, supply chains and distribution networks (middle box). The standard analysis of a transportation project might, for example, estimate the direct user benefits (e.g., truck driver travel time savings, reduced fuel and vehicle costs, and avoided crash-related fatality, injury, and property damage costs) and, for a large project, the construction-related benefits (e.g., jobs created, value of construction materials purchased, etc.). The monetary value of these benefits would be entered into a macro-economic model (typically, a regional economic model, such REMI, TREDIS, or RIMS). The model would generate an estimate of the economic effects of the reduced transportation costs and increased construction expenditures. The approach is effective for analysis of large projects involving substantial expenditures and significant, widespread changes in truck driver time and fuel use, etc., but it is difficult to trace the effect of specific projects to specific industries.

The approach recommended in this report is to more explicitly analyze the *logistics, supply chain and distribution network element* (middle box, Figure 4.1) – to understand how the transportation improvement will affect supply chains and logistics strategies, to understand how changes in supply chains will affect industry performance, and then to understand how changes in industry performance will impact the regional economy. Figure 4.3 shows the recommended sequence of analysis, which starts with the proposed transportation improvement and would be carried out as follows:

- Describe the freight transportation project. The project could be a capital improvement to a roadway, operational changes to reduce congestion (e.g., ramp metering); regulatory actions (e.g., driver hours) or land use policies (e.g., local jurisdictions reallocating permitted land uses) (side box, Figure 4.1).

Figure 4.3 Linkage between Transportation Improvements and Economic Impact



- Calculate the project's effects on freight transportation travel time; travel time reliability (e.g., ability to consistently meet pick-up and delivery windows); cost; and connectivity.[23]
- Estimate the effect of travel time changes, etc., on the industry supply chain. The effects can usually be measured as changes in productivity (e.g., lower production or distribution costs); or changes in market access (e.g., access to more markets at the same cost or access to the same markets at lower costs).
- Estimate the effect of the productivity and market access changes on industry competitiveness (e.g., market share, business revenues, profitability, etc.).
- Convert industry changes to employment growth (jobs) and economic output (GDP).

This analysis could proceed from the bottom up, starting with a specific project, and ending with an estimate of industry or aggregate regional economic impacts. However, the process could also be reversed. If MTC and ABAG were interested in targeting transportation investments to benefit a specific growth industry, the analysis could start with a specific industry sector, examine its logistics needs, and end with recommended projects that address specific physical or regulatory bottlenecks to that industry's goods movement and growth potential.

[23] Connectivity as reflected in network complexity or redundancy of paths and options to move between origins and destinations.

4.3 TECHNICAL RESOURCES FOR ECONOMIC ANALYSIS OF EFFICIENT GOODS MOVEMENT

Current MTC and ABAG Tools and Data to Reference and Leverage

MTC and ABAG have ready access to most of the data and tools needed to implement this approach. These include the following:

- Information about the proposed transportation projects and land use policies;
- Data on the location, capacity, and condition of freight infrastructure;
- Corresponding data on traffic volumes, flow patterns, and speeds by time of day;
- Census of business and industry establishments by type, employment, revenue and location, etc.;
- Transportation network models to generate volume and performance projections; and
- Regional economic models calibrated for the MTC/ABAG region to translate productivity and market access changes in quantified economic impacts, such as changes in business revenues and jobs.

Much of this data was collected through the 2004 MTC Regional Goods Movement Study and the 2008 MTC Goods Movement/Land Use Project; however, neither report provides detailed information about the supply chains and logistics strategies of Bay Area industries. The 2004 study provides a wealth of baseline data about goods movement in the region and the industries that generate the highest volumes of freight. The 2008 project expanded on the 2004 study by providing information on the trends and opportunities to improve the efficiency of goods movement in the Bay Area. The 2008 report contains 1) information on the types and breadth of business activities involved in goods movement in the central Bay Area, and the growth of those activities over time, 2) the industrial land supply along the central area study corridors that is needed to provide locations for goods movement businesses and policies and pressures that are reducing that supply, and 3) the implications of a more dispersed land use pattern in the future with goods movement businesses locating in outlying areas because of shortages of industrial land, while the demand they are serving grows in the central areas. Related studies, such as the 2009 San Francisco International Airport (SFO) study, provide information on the economic value of specific freight services for the region, such as air cargo operations, but they do not fill the missing link of supply chain information.

Approaches for the Next Update to *Plan Bay Area*

For *Plan Bay Area*, the materials developed from the 2004 and 2008 MTC goods movement studies were used to support the economic analysis of goods movement-related projects in the region. To date, there have been no updates of the baseline goods movement data, and no studies of the region's supply chains by industry. Therefore, we recommend that MTC and ABAG update their economic data and analysis tools before undertaking the next update to *Plan Bay Area*. The additional data and tools would make possible a better and more refined understanding of the economic impact of goods movement in the Bay Area. SCAG developed similar data and analytical tools as part of their Regional Goods Movement Plan element of the 2012 RTP/SCS. MTC and ABAG can build on the lessons learned from the SCAG work in updating the Bay Area goods movement work.

Recommended additional data and tools would include the following:

- **Industry logistics models.** General models of supply chains, such as the schematic map shown in Figure 4.2, are available to assist economic analysis. However, the most effective approach is to develop industry- and region-specific logistics models by directly interviewing representative industries in the Bay Area and their carriers. Within a given industry, the supply chain patterns of firms will usually be relatively similar. Since detailed information about the supply chains of individual firms is unnecessary for most multiyear transportation projects, it is possible to build a library of industry supply chain models relatively quickly and cost-effectively. However, to build meaningful industry supply chain models, MTC would need to update its commodity flow databases.
- **National and regional commodity flow tables.** The Freight Analysis Framework (FAF) data, available through the Federal Highway Administration, are useful for establishing control totals on commodities moving into, through and out of a metropolitan area, but lack the finer-grain resolution needed to analyze intra-metropolitan area goods movement. This information could be gathered by:
  - Purchasing commercial databases, such as IHS' TRANSEARCH that provide estimates of disaggregated county-to-county commodity flows by suballocating interregional flows based on industry location and employment data.
  - Conducting surveys at key truck weigh stations and airports to develop empirical data on freight flows. Local truck intercept surveys would provide a fairly good assessment of the region's commodity flow since there are relatively few freight gateways into and out of the Bay Area. Survey questions would focus on major origin-destination pairs, as well as the division between domestic and international cargos.

- **Truck routes and speeds.** Large and heavy trucks operate on a more restricted network of roads than automobiles and light trucks, reflecting bridge weight restrictions, overhead clearance restrictions, hazardous material route designations, roadway geometry (turn radii too tight to accommodate long trucks), and local community noise and time of day bylaws. Interstate highways, National Highway System routes, and designated intermodal access routes can be used as initial proxies for a truck route network, but a fully defined truck route network is recommended. General traffic speeds can be used as a proxy for average truck speeds; when more detailed truck speed data are needed, data can be purchased from commercial sources such as INRIX, or motor carrier industry research arms such as ATRI.
- **Updated goods movement land use information.** The 2004 study and especially the 2008 project, identified goods movement industries – including wholesale, food manufacturing, construction, etc. – that serve the central Bay Area. The 2008 project estimated the impacts on the transportation system if these industries were priced out of the central Bay Area. It would be beneficial to conduct a survey of these goods movement industries to: 1) determine the implications of land use changes (e.g., which have moved, which have stayed, where they moved); as well as 2) understand the implications of transportation system changes and proposed improvements.
- **Port gate survey and truck model development.** MTC and ABAG should consider partnering with the Port of Oakland to complete a truck survey and truck model for commodities moving to and from the port complex. Models of this type, such as the Port of Long Beach's QuickTrips model, can help in understanding the movements of trucks to and from the port, future volumes, the origins and destinations of these trips, and their implications for the region's transportation system.

5.0 Housing Policy and Access to Labor

5.1 INTRODUCTION

This section describes how MTC and ABAG could measure the economic impacts of housing policies and programs in the Bay Area's next *Plan Bay Area* update. Our focus is on the link between housing policy and economic impacts; therefore, we are not evaluating impacts of housing policy on affordability, equity, congestion, livability, or the environment.

From an economic perspective, the most critical role for housing policy has been and will remain the supply of housing in proximity to jobs. *Plan Bay Area* projects nearly 73% of Bay Area employment growth to be concentrated in professional services, health and education and leisure and hospitality economic sectors. This future growth depends on the ability to retain and recruit highly educated and appropriately-skilled workers. The larger and more diverse the proximate labor pool, the more competitive a firm will be relative to its peers.

Researchers have found a correlation between the level of diversity in metropolitan communities and the ability for these communities to attract a highly skilled and talented workforce.[24] Our evaluation of *Plan Bay Area's* economic impacts measured the economic benefits of increasing the supply of housing and improving access to a larger number and diversity of employees. This section presents three elements that we would recommend for improving this estimation in the next RTP/SCS:

- **Section 5.2** contains a three-part framework for measuring the impact of housing on the regional economy. The first describes how a firm's access to labor supports productivity by improving the matching of jobs and workers. The second part explains how housing policy impacts direct, indirect, and induced household spending in the region. The third part describes the short-term economic impacts of new housing construction in the Bay Area.
- **Section 5.3** reviews the technical readiness MTC and ABAG will need to analyze the economic impacts of housing policy in the Bay Area. This includes the availability of methods, analytic tools, and data necessary for future economic analysis.

[24] Edward Glaeser's City Journal article "Why Economists Still Like Cities" in spring 1996 is one of many examples over the last two decades citing this link.

Within these elements, we describe the most significant economic impacts of housing policies. Because the full spectrum of potential impacts is complex, the state of the practice for identifying all the impacts and measuring them reliably is still evolving.

5.2 FRAMEWORK FOR THE IMPACT OF HOUSING POLICY ON REGIONAL ECONOMY

We recommend evaluating three types of impacts on the regional economy.

1. **Access to labor**. The amount and proximity of housing to the number and types of jobs changes an employer's access to qualified workers. A change in the access to labor affects industrial productivity because employers recruit workers who are a better match for their needs; the better the match, the more productive the employee. Higher productivity improves a firm's competitiveness relative to its peers, which increases its market share and leads to more output, additional hiring, and increases in workers' personal income.
2. **Household consumption.** Personal consumption accounts for roughly 75 percent of the national economy. Regionally, the Bay Area's economy has roughly the same dependence on household spending, which is directly related to the amount of housing in the Bay Area.
3. **New construction.** Household spending includes outlays for rent or home mortgage. Housing policies that strengthen demand for new housing will increase construction of new housing units. This expands employment and personal incomes of workers within the residential development industry. In addition, this increase in industry activity generates temporary benefits to the regional economy.

These three types of impact are summarized in Table 5.1, including the measure, the brief description of effects measured, and the data and tools needed to conduct the analysis. Each of these measures is quantifiable and based on methodologies supported by previous research, studies, and available economic tools.

Table 5.1 Measures of Regional Economic Performance Specific to Housing Policy[a]

Measures	Economic Effects Measured	Data and Analytical Tools Needed
Access to labor	The size and diversity of the labor pool from which business can recruit workers. The number of workers within a 40-minute commute shed of jobs.	• Household population and employment by MTC superdistrict.[b] • Specialized economic I/O model accounting for access to labor effects (e.g., REMI or TREDIS). • Average commute drive times from MTC travel demand model (TDM)
Household consumption	Spending by households, leading to direct, indirect, and induced spending effects throughout the economy.	• Household population by income category. • Economic I/O model (e.g., IMPLAN, RIMS, REMI, or TREDIS).
New construction	Spending on new housing units, which generates temporary indirect and induced spending.	• Total number of new housing units by type or size of unit.[c] • Economic I/O model.

[a] As stated above, these measures do not include benefits to the regional economy due to travel time benefits, nor housing affordability. The former is part of transportation benefits; the latter is part of equity analysis.

[b] *Plan Bay Area* aggregated the approximately 200 PDAs into 34 superdistricts within the nine-county Bay Area. The TREDIS model can evaluate economic impacts of access to labor at the zip code level, but this fine granularity exceeds the sensitivity in TREDIS to capture the variation in changes in market access. Superdistricts were determined as the appropriate zone size for this level of analysis.

[c] Methodologies are available to estimate new housing units and types based on population and employment estimates.

The methodologies for analyzing these three measures are described below. The results of each of the analyses would include the direct, indirect, and induced economic effects, where applicable. Direct economic effects are employment and output that results from economic activity. Indirect economic effects result from industrial sectors that support the primary economic activity, such as suppliers and related services. Induced economic effects include the effects of spending which results from changes from economic activity, such as increases in employee income.

Access to Labor

Improving the access to a large, diverse, and qualified pool of labor affects increases in the productivity of firms relative to other firms in their industry. Productivity is the value added per employee. The better a firm has access to the best qualified employees, the better employers can find an employee to match their needs. A synthesis of the research in this field was described by Paul Krugman in his 1991 paper *Increasing Returns and Economic Geography*, for which

he won the Nobel Prize.[25] Krugman posited that benefits arise from five economic effects of higher residential and industrial densities: access to labor, matching, sharing, knowledge spillovers, and competition. The first effect relates to the supply and location of housing for employed residents or the travel times for commuters. The latter four effects are the result of businesses' proximity to one another (i.e., business agglomeration). These latter effects are not directly relevant to our focus on housing policy.

Improving the access to labor effect is supported by increasing the size of the qualified labor pool. Increasing a firm's productivity vis-a-vis competing firms in other regions will lead to an increase in the firm's market share, which increases that firm's employment and output, in turn, expanding GRP and regional employment. Improving access to labor also attracts businesses, both start-ups and firms from other regions looking to relocate or expand their operations.[26] Business attraction occurs for the same reasons that existing Bay Area firms expand.

The Bay Area's economy may be more sensitive to the supply and proximity of housing to jobs than other metropolitan regions because it has a higher concentration of professional service industries, which include technology developers (e.g., research and development firms, biotechnology).[27] Firms in these industries typically are more sensitive to labor access than other industry sectors, such as manufacturing and services, due to the demographic profile they attract. Skills needed in professional service firms are evolving so quickly that access to a younger, very highly educated workforce is the most critical competitive advantage in these industries.

The alternative land use scenarios formulated for evaluation in *Plan Bay Area* included estimates of the amount of housing needed for each household income strata and its proximity to jobs. All of these scenarios projected a level of housing relative to what the marketplace and regulatory restrictions would provide, rather than compared to a no-project or business-as-usual base case. In

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[25] Krugman, Paul, 1991, "Increasing Returns and Economic Geography," *Journal of Political Economy*, 99, 483-499.

[26] Chapple, Karen, and Carrie Makarewicz, 2010, *Restricting New Infrastructure: Bad for Business in California?* Access No. 36, pp. 16-21.

[27] Professional Service Firms (PSF) are generally defines as having high knowledge intensity and a professionalized workforce, but are placed into the following four categories:

1. Classic PSFs (e.g., law and accounting firms), which have low capital intensity;
2. Professional campuses (e.g., hospitals), which have high capital intensity;
3. Neo-PSFs (e.g., management consultants), which have low capital intensity; and
4. Technology developers (e.g., R&D firms, biotechs), which have high capital intensity.

the absence of a no-project scenario, the degree of housing growth and resulting economic impact comparison is difficult to gauge.

Household Consumption

The economic impacts of changes in household spending may be measured by starting with the assumed increase in households categorized by income strata. While this forecast can be analyzed at the county level, aggregating the growth into a nine-county regional total would be a reasonable simplification. While we are recommending that land use scenarios be developed using a robust analytical approach (e.g., UrbanSim, pro forma analysis), analysis of the economic impacts of household spending would not differ based on the market validity of the assumptions about future residential development.

The methods estimate the amount of consumption spending by each house in each income strata. I/O models, such as IMPLAN or RIMS[28], provide these for the current years. Forecasts for future *Plan Bay Area* planning horizon years will use projections from ABAG, the Center for the Continuing Study of the California Economy, or other economic forecasts chosen for the update of the Plan. Direct expenditures by households are then plugged into an I/O model, which estimates induced spending. Multiplier effects are then derived for household spending patterns across each income group to include only the induced effects, but not direct or indirect effects. The economic effects are displayed as induced effect only, as changes are made to household spending and not directly in industrial sectors, which would include direct and indirect effects. A June 19, 2012 memorandum, analyzing the economic pacts of the No-Commute Alternative for the *Plan Bay Area* Environmental Impact Report to MTC, provides a detailed description of this methodology.[29]

New Housing Construction

A recent study by the Center for Housing Policy found that, on average, each new housing unit constructed in the Bay Area resulted in approximately $422,000 in economic output, and resulted in the creation of 1.7 new jobs during the construction phase.[30] While temporary, construction of new housing units results in quantifiable regional economic impact. The update to *Plan Bay Area*

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[28] REMI or TREDIS also can be used, although the added cost and sophistication of these models are unnecessary to conduct this analysis.

[29] Cambridge Systematics memorandum to Ashley Nguyen, MTC, *Employment Findings from a "Housing Opportunities for Bay Area Workers" Scenario: What Happens When Bay Area Workers Are Provided with Housing Opportunities*, June 19, 2012.

[30] Center for Housing Policy (2010) Building California's Future: An Economic and Fiscal Analysis of Housing Construction in the Golden State, accessed September 2012 at http://www.hcd.ca.gov/ BuildingCAFuture.pdf.

update could include an economic analysis of new housing construction stimulated by housing policies that increase housing supply above that assumed in a no-project/business-as-usual base case. The direct effects are attributed to residential building trades. Indirect effects accrue to the construction-supply industries, and induced effects are generated from household spending generated from direct and indirect employment: both economic effects ripple throughout the regional economy.

Construction of new residential units is treated as an investment (a borrowing on future household income streams), and is not part of household spending patterns in an I/O model. Therefore, construction spending is not included in the household consumption modeling efforts described in the previous section. Nevertheless, the same I/O model used for that evaluation will apply to housing unit construction impacts.

Economic models incorporate housing construction as an investment shock to the construction industries. To conduct the analysis, we would use the total cost of constructing all new housing units as an input to the economic model. To estimate this cost, we would use population or employment data from the next update to *Plan Bay Area* to yield an estimate of the number of new households by income category based on occupation type. Income categories will allow for specification of construction costs based on the type of unit. ABAG provides this data and has previously forecasted the number of new housing units by type and price as part of the RTP/SCS process using assumptions based on employment forecasts by industry.[31]

Construction of new housing typically occurs over two to three years, resulting in relatively short-term economic effects. The monetary cost of new housing will be factored over the 25-year timeframe of the next update to *Plan Bay Area*, including inflation and assumptions on when the construction spending occurs. The results include the direct, indirect, and induced effects of housing unit construction in terms of output, jobs, and personal income. Industrial-level detail illustrates impact by industry sector and occupation. The results could be presented as a total regional benefit, and/or presented in terms of per unit output and jobs.

[31] Chapple, Karen, 2012, Evaluating the Effects of Projected Job Growth on Housing Demand, Technical Memorandum to ABAG; accessed August 2012 at http://www.onebayarea.org/pdf/KC_Effects_of_Projected_Job_Growth_on _Housing.pdf.

5.3 TECHNICAL READINESS FOR ECONOMIC ANALYSIS OF HOUSING POLICY

Current MTC and ABAG Studies to Reference and Leverage

The economic impact of the *Plan Bay Area* land use scenarios was evaluated in a number of reports during the plan's preparation. These include one by Stephen Levy (Center for Continuing Study of the California Economy), which provided analysis for the employment forecasts used by ABAG for *Plan Bay Area* that included 11 industrial sector groups.[32] Karen Chapple analyzed Stephen Levy's job forecasts to estimate the effect on regional housing need based on these industrial sector groups and unpacked the data to the three-digit NAICS level of 54 sectors.[33] These documents provided key methodologies and data for developing future economic analysis of housing policy and should be continued forward in the planning process, both in development and evaluation of scenarios. In addition, other reports related to housing policy include ABAG's development of the Regional Housing Need Assessment (RHNA), which provides an eight-year estimate of housing need by jurisdiction in four income categories. While the assessment is a shorter timeframe than the *Plan Bay Area* timeframe, methodologies may serve as a resource for economic analysis.

MTC and ABAG also used the TREDIS software and IMPLAN model to analyze the economic impacts of the land use scenarios in *Plan Bay Area*. TREDIS is an off-the-shelf economic model available from the Economic Development Research Group (EDRG)[34] TREDIS includes a market access module, which applies more than 100 simultaneous econometric equations, based on EDRG's national economic research, to relate residential and employment proximity with economic measures – in this case, county-level economic output, per capita income, and labor productivity. In particular, the model captures benefits of labor access by measuring the total population within a 40-minute drive time from the population-weighted center of a selected analysis area. In *Plan Bay Area*

[32] Levy, Stephen, 2012, Bay Area Job Growth to 2040: Projections and Analysis, prepared for Association of Bay Area Economics, Palo Alto, California, accessed August 2012 at http://www.onebayarea.org/pdf/3-9-12/CCSCE_Bay_Area_Job_Growth_to_2040.pdf.

[33] Chapple, Karen, 2012, Evaluating the Effects of Projected Job Growth on Housing Demand, Technical Memorandum to ABAG; accessed August 2012 at http://www.onebayarea.org/pdf/KC_Effects_of_Projected_Job_Growth_on_Housing.pdf.

[34] MTC, May 2012, Preferred Land Use Scenario/Transportation Investment Strategy, accessed August 2012 at http://apps.mtc.ca.gov/meeting_packet_documents/agenda_1875/ Item_4a_Pref._Land_Use_Scenario_Transp._Invest._Strategy.pdf.

analysis, 34 superdistricts were used for analysis areas.[35] The 40-minute threshold represented the 80th percentile for average commute time in the U.S.

Several other studies can inform how housing policy will impact the Bay Area's economy. Joint Venture Silicon Valley prepares an annual report on the economy in San Mateo and San Jose Counties that analyzes industries at a high level of detail.[36] The Bay Area Council's Economic Institute, Silicon Valley Leadership Group, and the Urban Land Institute have all provided in-depth analysis of drivers of the Bay Area economy, and propose recommendations regarding transportation and housing that are expected to grow the regional economy. The underlying analysis provides key information for future studies and policy recommendations to evaluate as part of scenario development for updates to *Plan Bay Area*.

MTC and ABAG are already using the Housing and Transportation (H+T®) Affordability Index to evaluate housing policy. The Center for Neighborhood Technology's H+T Affordability Index provides a more comprehensive way of thinking about the cost of housing and true affordability. The Index shows that transportation costs vary within the Bay Area region, depending on neighborhood characteristics. The H+T Index is sensitive to the accessibility of housing to jobs, in addition to services, transit, and amenities, as well as land use density and mix. While primarily an indicator of equity issues and not economic issues directly, the Index may provide useful data for economic analysis, as well as a benchmark for the household consumption element of the recommended analysis framework.

Finally, MTC and ABAG staff have become more experienced in interpreting results from economic models, especially when applied to housing policy. During the *Plan Bay Area* development process, MTC and ABAG staff worked closely with a number of experienced economists to prepare the data needed to analyze the economic impacts of the land use scenarios in *Plan Bay Area* and interpret the results. The experience from measuring economic analysis as part of the performance of *Plan Bay Area* builds capacity for both agencies for future Plan updates.

Methodological Changes Suggested for the Next Update to *Plan Bay Area*

In the next update to *Plan Bay Area,* the first of four recommended changes in the measurement of economic impacts of housing policies would be to incorporate

[35] TREDIS is calibrated at the county level, which makes analysis at the smallest scale – by zip code – subject to data noise that would obscure the results of the model. Superdistrict-level analysis provided sufficient agglomeration of data without losing effects of local area land use.

[36] Joint Venture Silicon Valley, 2013, Index of Silicon Valley, San Jose, California.

all of the direct impacts from policies and funding necessary to implement the residential growth assumed in each land use scenario. Some of these direct impacts will require identifying the quantitative amount of funding and the specific sources needed to achieve the projected growth in the scenarios. One example is a scenario that assumes a higher density and mix of residential and/or commercial development specified in particular PDAs than what the demand for that type of land use will support. A recent development submodel added to UrbanSim has the functionality to estimate the costs needed to tip the market enough to make new development feasible. The subsequent economic analysis, however, requires that the amount and precise source of the funding be identified. In the past, local jurisdictions supported below-market-rate development from redevelopment funds (i.e., tax increment). Given these funds are no longer available, the funding will need to come from a new source. UrbanSim also can evaluate the market feasibility of some policies such as zoning changes, parking maximums, floor-area ratios, height restrictions.

The second recommended change involves the formulation of a no-project or business-as-usual base case scenario, which will then allow MTC and ABAG to measure the difference, or delta, of economic impacts rather than evaluating the projected outcomes in absolute terms. These deltas provide decision-makers and stakeholders with a more controlled evaluation of each scenario's performance while holding all other influences constant. The need to control for a multitude of significant and unpredictable market forces is essential when conducting economic impact analysis. Comparing the performance of different scenarios relative to a base case provides reasonable basis for selection.

Third, we recommend enhancing the approach of measuring population within a specific commute shed. In our previous analysis, we applied the standard 40-minute threshold. Bay Area commute sheds differ by city and may be more or less than 40 minutes. Karen Chapple evaluated changes in job growth on housing price appreciation in the Bay Area and used commute sheds that were unique to each municipality based on commute times from the 1990 Census Transportation Planning Package, which were generally less than 40 minutes.[37] This suggests that tailoring the commute shed using regional travel data may improve the accuracy of the analysis.

The fourth change involves refinements to the diversity and detail of the performance metrics used to report the impact of each scenario. The economic analysis of *Plan Bay Area* used a single GRP value for each of the five draft scenarios, as well as the preferred scenario. GRP alone is not a sensitive economic indicator for evaluating alternative housing policies. Other measures of economic performance, such as per capita and household income and worker

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[37] Chapple, Karen, John V. Thomas, Dena Belzer, and Gerald Autler, 2004, Fueling the Fire: Information Technology and Housing Price Appreciation in the San Francisco Bay Area and the Twin Cities, Housing Policy Debate Vol. 15, Issue 2, pp. 347-383.

productivity, may provide more sensitivity. To test this sensitivity, we recommend possibly increasing the detail of industrial sectors in the land use scenarios included in the next update to *Plan Bay Area*. This could improve the analysis of how housing policy affects different industries within the region, and provide consistency between different regional analyses (i.e., access to labor, housing affordability). The data is readily available from the U.S. Census Bureau, Bureau of Labor Statistics, California Employment Development Department, and other government agencies.

6.0 Market Feasibility of Priority Development Areas

The discussion on the previous four topics included in this report (state of good repair, goods movement, roadway pricing, and housing policy and access to labor) all focus on how analysis can be undertaken to determine economic impacts. Refinements to measuring the market feasibility of Priority Development Areas (PDA) will have an impact on the ***inputs*** that are used in conducting economic impact analyses. The refinements discussed below can lead to greater accuracy and informative economic impact analyses.

6.1 INTRODUCTION

In *Plan Bay Area,* 78% of new housing and 62% of new job growth is projected to be located in PDAs throughout the nine-county Bay Area. PDAs are locally-identified infill development opportunity areas that have access to rail, ferry or bus service with frequencies of 20 minutes or less during peak commute hours.

The implied economic assumption behind the creation of PDAs is that compact growth in select, concentrated transit nodes will link land use and transportation, resulting in efficient access to destinations with or without a passenger vehicle trip.

This section focuses on the methods, data and tools needed to measure the sufficiency of market demand to accommodate projected growth in PDAs.

- Section 6.2 summarizes two quantitative methods to apply market feasibility analysis to determine to what extent total growth in the region could be absorbed in PDAs. The first method applies a real estate pro forma analysis available in the UrbanSim model, which is a regional land use simulation model. The second method is to determine the market feasibility of each PDA or a logical aggregation of PDAs and relate the individual results to regional economic performance.
- Section 6.3 describes an update to the technical readiness MTC and ABAG completed in *Plan Bay Area*. This includes the availability of methods, analytic tools, and data necessary to accomplish this analysis.

These methods can be used to quantify the constraints to achieving land use targets in specific PDAs in the next *Plan Bay Area* update. Further analysis will be needed to identify policy changes that will enable development in PDAs. These enhancements to the methods are described in Section 6.3.

6.2 METHODS FOR ECONOMIC ANALYSIS OF PDA MARKET FEASIBILITY

ABAG and MTC incorporated two methods for evaluating PDA market feasibility in *Plan Bay Area*. The first was a regional approach that involved the application of the UrbanSim Model and its Real Estate Development submodel[38]. The second was a case-study approach that assesses a subset of individual PDAs and applies the results in the *PDA Development Feasibility & Readiness Assessment*, a study completed March 29, 2013[39]. This case-study approach could be scaled up from the 20 PDA analyzed to cover most, if not all, PDAs in the next RTP/SCS.

These two methods are summarized in Table 6.1, including a summary of the approach and data and tool requirements for use in the next *Plan Bay Area* update.

Table 6.1 Methods to Measure Market Feasibility of PDAs

Method	Approach Highlights	Data Requirements/Tools Needed
UrbanSim Real Estate Development Submodel	Builds a real estate pro forma analysis that simulates a project-level scenario where developers are trying to maximize profits, thus, considering the feasibility of developing a particular site within a parcel	• Parcel level data on households, businesses, and buildings • Model inputs, such as prices, rents, absorption, parcel size, zoning, policies, and demolition costs • UrbanSim simulation software
PDA Readiness Assessment	Assesses the development readiness and feasibility of approximately 20 of the region's PDAs	• PDA Development Feasibility and Readiness Assessment • Market demand analysis

UrbanSim Real Estate Development Submodel

The Real Estate Development submodel of the UrbanSim simulation software is being developed by Paul Waddell (UC Berkeley) through collaboration with MTC and ABAG. The submodel is embedded in the Bay Area UrbanSim model. The submodel builds a real estate pro forma analysis that simulates a project-level scenario, where developers are trying to maximize profits given a site's constraints. The algorithm combines parcel level data with outputs from other submodels to generate out-year assessments of development feasibilities for thousands of projects for every year simulated.

[38] http://analytics.mtc.ca.gov/foswiki/Main/LandUseModel

[39] http://onebayarea.org/pdf/final_supplemental_reports/FINAL_PBA_PDA_Development_Feasibility_and_Readiness.pdf

Data Needs for the Real Estate Development Submodel

UrbanSim and the Real Estate Development submodel require parcel-level data. For each parcel record, the model has fields describing the attributes of existing structures and information about the households and businesses that occupy these structures. Information about planning restrictions is also coded to each parcel. The following are key parcel-level model inputs required for running the submodel in a given simulation year:

- **Prices and rents.** Dollars per square foot for single family, multifamily, office, retail, and industrial;
- **Absorption.** Sales absorption, sales vacancy rates, rent absorption, and rent vacancy rates;
- **Parcel size.** Lot size;
- **Zoning.** Allowable building types, allowable floor area ratio, height restrictions, and maximum number of dwelling units;
- **Policies.** Other fees or subsidies that change the profitability of construction; and
- **Demolition:** The cost of site preparation per square foot that applies only if there is an existing building.

The submodel is composed of two key parts: a building optimizer and a standard pro forma analysis. These components are intended to replicate the process a developer would follow to determine the feasibility of a project. The building optimizer develops a variety of buildings (in terms of type, units, and size) on the site, while obeying zoning limitations. The pro forma analysis then evaluates the potential projects and selects the most profitable project among the different options. This evaluation process may be applied across numerous parcels within a PDA. The program benchmarks the performance of each potential project's profit against a normal profit (which can be varied). If the project generates a profit (i.e., a hurdle rate) deemed sufficient by the model users, the project is built.

The pro forma analysis takes inputs from two different sources within UrbanSim. The first is the parcel–level information. This includes information about the building currently on the site (if there is one) and its zoning. The second source is information developed by the annual updating of the other UrbanSim submodels. For example, relevant submarket price and absorption rates for a potential project on the parcel are determined by UrbanSim.

The algorithm searches parcels randomly with the goal to build profitable buildings. Overall, the model tends to maximize profit by erecting buildings in areas that have scarce land, low vacancy rates, and high prices to the extent that planning limitations allow. The output of the model is a long list of individual buildings that have types (single-family dwelling, multifamily dwelling, retail, office, etc.); size (units or square feet); and a price. This repeats each year after all

other submodels incorporate the relocation of households and firms into these new buildings, among others.

The use of a parcel-level approach allows the model to combine the specific conditions that affect a parcel's development with regional economic trends. For example, the probability that a specific parcel will absorb a large occupied building depends on the overall regional demand for employment (or housing), and the specific zoning, fees, and subsidies applying to that parcel. This geospatial detail allows the model to test the sensitivity of the type of targeted zoning, tax, or fee policies typically considered in efforts to concentrate growth in particular areas such as the PDAs. This functionality will, for example, enable MTC and ABAG to determine the need for and magnitude of financing necessary to achieve a particular growth pattern. Because feasible land use scenarios are the outcome of fiscal and land policies, MTC and ABAG can estimate the gaps between desired policy outcomes.

In addition to the Real Estate Development submodel, UrbanSim also implements a Scheduled Development Events Model (SDEM) that allows the user to place new developments into the model independent of market demand. Before California abolished redevelopment agencies and funding in 2011, this would have allowed a user to test the potential catalytic effects of redevelopment projects on adjacent parcels. Even after the abolishment of redevelopment funds, the coupling of these two tools could be applied to test the potential for a new public development (e.g., new military or academic research facilities, hospitals, sports facility, or attraction of new direct foreign investment) that would leverage ancillary market-driven development.

Integrated Modeling System

In the medium term (roughly five years out), the Real Estate Development submodel provides a more automated replication of the approach developers typically use to evaluate the feasibility of a project, given the market conditions they and their investors expect. The advantage to this approach is that UrbanSim can integrate large amounts of data to simulate many pro forma analyses very quickly. Additionally, UrbanSim explicitly recognizes that the PDAs are competing amongst themselves, as well as with non-PDAs, for development. On top of this, the building optimizer can make simplifying assumptions about key site-specific conditions that a developer would research and customize. Both assumptions are easily modified and sensitivity testing may be used to determine which assumptions are critical. In the long run (five to thirty years out), the integration of UrbanSim's submodels with the Travel Model also incorporates the role of transportation in driving urban development. For example, the modeling of a policy that shifts resources toward additional transit service will spur additional development of particular types of buildings, all else equal. While these longer term forecast are by their nature more speculative, such an effort provides useful order-of-magnitude information on the interactions between transport and land use change.

Model Limitations and Potential Remedies

The current integrated modeling system provides the strongest regional approach available to understanding development feasibility. Enhancements to the model are ongoing. The fixed parcel boundaries, for example, are being modified to allow for parcel agglomeration and subdivision with accompanying costs during the model run. Nevertheless, a number of improvements would strengthen its application to the next update of *Plan Bay Area*. One set of planned improvements will focus on strengthening local feasibility assessment. This would allow its use in local scale assessment. The model developers have expended significant effort to collect zoning for each parcel, but the local fee information is incomplete. Current methods to offset this lack of data rely on calibration factors to adjust outcomes. In addition, the model developers acknowledge a need for more qualitative information about local community-driven type factors, which would improve the model's sensitivity to these significant local constraints and improve the prediction of PDA feasibility.

PDA Readiness and Feasibility Assessment

As noted above, MTC and ABAG undertook new research examining PDA development readiness and feasibility through the PDA Development Feasibility & Readiness Assessment, a supplementary report to *Plan Bay Area.* The project consultant team evaluated 20 PDAs representing a range of place types to determine their relative development feasibility and readiness to take on the 2040 residential growth, as projected in *Plan Bay Area*. The analysis evaluated PDA feasibility across six types of constraints: 1) policy (i.e., rezoning, parking ratio reductions, rezoning, and entitlement streamlining); 2) market; 3) infrastructure; 4) site-related; 5) financing; and 6) financial feasibility. (These constraints are defined on page 4 in the PDA Feasibility Assessment.)

The Assessment compiled available estimates of the development capacity within each PDA in the sample based on known development conditions (vacant or underutilized parcels), and existing or currently contemplated planning regulations. Financial viability of the developable parcels was evaluated from a market perspective, based on observed market conditions, comparative pricing among jurisdictions, and generalized development revenue/cost parameters (e.g., the ability for market rents to cover the costs of underground parking, if required to achieve envisioned densities). For relevant PDA infrastructure costs, the conditions and constraints are characterized qualitatively, unless such costs are provided in Specific Plans or other preexisting documents relevant to each PDA.

For each PDA in the sample, the assessment described existing conditions and summarized major constraints (if any) to achieving the SCS-projected growth. Both city planning staff and developers familiar with the jurisdictions included in the sample were consulted during the data collection process. The study also highlighted actions that have proven effective in advancing infill development and other *Plan Bay Area* goals within the sample set communities. Examples

include parking ratio reductions, public infrastructure investments, rezoning, and entitlement streamlining.

Policy Areas for Refinement

Another component of the *PDA Readiness Assessment* identified how future financial resources and policies could improve the feasibility of the planned development in each of the 20 case study PDAs through the horizon year of the Plan. The consultant team applied specific policies (e.g. zoning changes) and public infrastructure funding to each of the PDAs to overcome constraints identified under current conditions. The assessment then estimated the amount of additional housing development that would occur in 2010, 2030, and 2040 (the horizon year of *Plan Bay Area*). The Assessment compared these results to a forecast of housing development without the policy changes and additional funding to illustrate the difference that such strategies can make to increase the feasibility for planned growth within the PDAs.

Development Readiness and Feasibility in Non-PDA Areas

While *Plan Bay Area* directs a substantial portion of the expected regional growth through 2040 to the PDAs, new population and employment are expected to locate in non-PDA areas as well. The study also examined development feasibility and readiness in non-PDA areas within the region. The report concluded that in most instances, non-PDA areas will face development constraints similar to those found in PDAs.

6.3 APPLICATION OF THE ASSESSMENT RESULTS TO AN ECONOMIC IMPACT ANALYSIS OF THE NEXT RTP/SCS

The Assessment results showed that without policy changes and greater financial investments than those included in *Plan Bay Area*, approximately 20% of development intended to occur within PDAs may not materialize. These results have implications on an economic impact analysis because if growth in PDAs is not as robust as projected, then the economic impacts from a project development pattern will be affected. A full specification of the policy changes and amount of funding to achieve projected growth is key to measuring economic impacts.

The Assessment, in combination with the application of the UrbanSim model, should provide guidance on the specific policy changes or investments needed to achieve a particular land use scenario. This guidance, for example, may include the need to lower the cost of land for a specific PDA so it can attract enough commercial office development to increase the density assumed in a land use scenario.

Measuring the direct impact of some policies needed to achieve a certain land use outcome, however, remains difficult to quantify. The direct impacts on land use from parking cashout programs or parking pricing, for example, remain beyond the reach of current analytical methods. Therefore, an economic analysis would not have the direct impacts from these policies to use as inputs. Nevertheless, SFpark and the San Francisco County Transportation Authority are working on developing analytical methods that measure the direct impacts of these policies and other parking and TDM strategies. Over the next few years, MTC will be gathering information regionally on parking supply, demand, and policy with the goal of integrating this information into UrbanSim's Real Estate Development submodel. This effort may allow regional assessment of the potential role of parking policy modifications in increasing the feasibility of residential development in the PDAs.

Given the direct impacts of new policies, new public funding, or reallocation of public expenditures, economic models such as REMI, IMPLAN or TREDES can measure the economic impacts. In the next update to *Plan Bay Area*, we anticipate that the application of the UrbanSim model, as well as the methodologies developed in the *PDA Readiness Assessment*, could provide a more robust assessment of the complete set of direct impacts from policies and other expenditures needed to achieve the land use scenarios, which may then be included in a future economic impact analysis.

A. Annotated Bibliography of Past Studies

A.1 STATE OF GOOD REPAIR

Regional economic analysis of SGR investments has been completed in a small number of past studies in the Bay Area, other regions, and nationally. None of these, however, employs sufficiently rigorous methodologies or comprehensive findings to measure the economic impacts of *Plan Bay Area*. Nevertheless, the following summaries of the available research provide examples of the state of the practice. The first part of this section provides summaries of reports representative of a variety of analysis, methodologies, and geographic areas. Each summary includes reference information, a narrative summary, and several key results based on analysis of investments supporting transportation asset SGR. The second part of this section provides brief summaries of economic modeling tools discussed in this report, and referenced in Table 2.2.

Relevant Studies

State of Good Repair Study for BART: Regional Impacts Study (2012), Deakin, Elizabeth, et al., Oakland, California

This recent report for BART analyzed the consequences of not maintaining an SGR for the BART system. Needs estimates, based on methods developed by the FTA and BART data, indicate that BART needs to spend more than $500 million each year on the core system ($15 billion over 30 years), if it is to attain and maintain SGR over the next 30 years. MTC's *Transportation 2035* funding plan identifies about $250 million a year for BART's rehabilitation and replacement. The study provides an evaluation of capital funding scenarios where BART can cover only 30 percent or 50 percent of SGR costs. The results included:

- Investments in transit should return $1.70 in business activity for every dollar spent on the improvements (benefits from travel time savings are in addition to this);
- Investing only 30 percent of the amounts needed for an SGR would cost the region at least $33 billion in lost business sales (economic output), due to travel delays on transit that increase user costs, as well as increases in roadway congestion that lead to further declines in business productivity; and

- Investing only 50 percent of needed amounts would cost the region at least $22 billion in lost business sales.

Due to this study's development for a major transit provider in the Bay Area, the methodologies presented are directly applicable to future economic impact studies. While exact processes would need to be further developed for other local transit providers, the general framework and data sources would be similar.

Economic Impact of Public Transportation Investment (2009), Weisbrod, Glen and Reno, Arlee, prepared for the Transit Cooperative Research Program Project J-11, Task 7, by the Economic Development Research Group and Cambridge Systematics, Inc.

This report uses national and international best practices to evaluate how investment in public transportation affects the economy in terms of employment, wages, and business income. Key findings of the report are organized in terms of two categories: 1) the effect of spending money on public transportation, which creates immediate jobs and income by supporting manufacturing, construction, and public transportation operation activities; and 2) longer-term effects of investment in public transportation, which enables a variety of economic efficiency and productivity impacts to unfold as a consequence of changes in travel times, costs, and access factors.

The investment impacts included directly supported jobs at manufacturers and at operators of public transportation equipment and facilities, plus additional indirect jobs supported by orders for other product and service providers, and induced jobs supported by consumer spending of workers' wages. These overall impacts represent new jobs insofar as there is an increase in public transportation spending and a sufficient number of unemployed persons to fill these jobs. The results included:

- Capital investment in public transportation (vehicles and equipment, other infrastructure and supporting facilities) supports nearly 24,000 jobs per billion dollars annually.
- Public transportation operation spending (i.e., management, operations, and maintenance of vehicles and facilities) supports more than 41,000 jobs per billion dollars annually.
- Combined, these investments resulted in approximately $3.6 billion of added business output, which provides $1.8 billion of gross domestic product. This additional economic activity generated nearly $500 million in Federal, state, and local tax revenues.

This study provides a framework for evaluating the broad economic effects of capital investments in public transportation, as well as ongoing investments in maintaining SGR. The study also provides an example of how economic modeling tools and software can be leveraged to develop large-scale measures of economic activity, such as business output and employment. The results at the national scale would provide a useful comparison to regional economic activity.

Productive Highway Capital Stocks and the Contribution of Highways to Growth in GDP (2007), Fraumeni, Barbara M., prepared for the FHWA, Washington, D.C.

The FHWA assessed the economic impacts of using measures of highway capital stock, which is defined as the current value of the nation's highways, roads, and bridges. The current value was estimated by depreciating historical highway investment patterns according to the expected productive life of the highway assets. Using model components from HERS (see next part of this section), Fraumeni's economic estimates incorporated the long-term deterioration of pavements and bridges, as well as the added travel time and vehicle operating costs associated with operating on deteriorated pavements. No adjustments were made for travel time and vehicle operating costs associated with increasing congestion. Key points from the study include:

- Estimates of productive highway capital stocks for the interstate, noninterstate state, and local systems are close to $1.5 trillion (in 2000 U.S. dollars).
- The value of the capital stock has been steadily increasing since 1956, but the rate of growth has slowed somewhat in recent years. If adjustments were made to reflect the declining productivity associated with increasing congestion, the slowdown in recent years might be even greater.

This national-level analysis provides an alternative method to quantify the effects of SGR by assigning value to the current worth of existing infrastructure, which may be of interest to the region. This value can be compared across different future (and past) scenarios. The highway capital stock measure may effectively communicate loss of economic value due to changes in asset conditions, in addition to measures of current investment needs. This study also provides clear methodology for extracting data and modeling tools from HERS to conduct broad economic analysis of SGR investments.

The Price of Inaction: An analysis of economic impacts associated with Southeast Pennsylvania Transportation Authority's (SEPTA) FY 2008 Operating Budget Plan B Alternative (2007), ***Economy League of Philadelphia, Philadelphia, Pennsylvania***

In this report the Economy League of Philadelphia, a local private business advocacy organization, analyzed the economic impacts of the regional transit agencies' "Plan B" investment plan on individuals, businesses, governments, and the region's overall competitiveness. The analysis builds upon generally accepted data sets and research models, including SEPTA's ridership figures, Delaware Valley Planning Commission congestion modeling, Philadelphia Tax Reform Commission work, and U.S. Census data. The study incorporates regional economic costs in the economic model by treating additional transportation costs as an increase in local taxes. The results included:

- Fare increases would cost $22 million in new travel costs for riders who switch to using cars, and would cost current drivers an additional $39 million

annually due to increased congestion and parking prices when commuting to Center City.

- Philadelphia would lose 43,800 jobs and $1.7 billion in net earnings.
- City property values would decrease by 6.5 percent, or $2.9 billion; a typical city home would lose $7,400 in value.
- City wage tax revenues would decrease by $60 million. State personal income tax revenues would decline by $27 million. These reductions in funding would further strain the ability of municipalities to provide residents with core services.

This study provides an example of applying economic analysis at the regional level. While the key issue of fare increases is not the purview of MTC/ABAG's regional planning efforts, the analysis provides one example of how changes in transit may affect rider travel choices. In addition, the study uses values of time, and applications of economic models may provide sample methodologies for the Bay Area, depending on available data and economic modeling tools available.

Lasting Economic Benefits of Public Transportation investment (1997), Cambridge Systematics, Inc., prepared for the New York City Transit Authority, New York

This report on the economic benefits to the New York City region of investing in transit included the effects of SGR investments. The research was based on experiences in New York when transit service performance decreased in response to severe underinvestment in maintenance and operations. The study considered the impacts of alterative transit capital investments on both highway and transit levels of service, as well as the effects to users. Other key points include:

- The study assumed that about $49 billion was needed to bring the system to an SGR;
- Under an SGR scenario, a typical user would experience an incident of service delay every 26 trips, versus every 6 trips under the 50 percent disinvestment scenario;
- A 50-percent reduction in needed funding would result a $4.34 loss to the economy for every dollar not invested in the public transit system, or $63 billion in terms of net impacts;
- A 25-percent reduction in funding would result in a $4.00 loss for every dollar not invested in transit, or $29 billion in terms of net impacts; and
- A $7.75 billion expansion of the system beyond basic improvement and replacement needs (SGR) over the 20-year period would yield regional economic benefits of $15.8 billion.

This study formed part of the basic structure of the BART study, summarized above. While the more recent study provides the most relevant framework and

data for future MTC and ABAG economic analysis, this study was summarized to provide context for the local efforts. In addition, summarizing economic metrics in terms of dollars of benefit per dollar spent is one example of a simple, yet powerful communication method.

Modeling Tools and Data Sources

MTC StreetSaver

In 1987, MTC created a pavement management software system called StreetSaver in response to a study by MTC that found that local roadway maintenance spending fell short by $100 million annually, and that the Bay Area had a deferred maintenance cost of up to $500 million. StreetSaver® uses a pavement condition index based on survey data to measure the condition of a given section of roadway. The index helps to establish the extent of repair required and estimate repair costs, and provides real-time and projected estimates based on assumptions of treatment strategies either by road segment or areawide.

StreetSaver was designed to estimate the optimal, SGR condition and associated costs, where ongoing maintenance is the most cost effective over a long-term scenario. The model also can be used to estimate the costs to achieve a target index, as well as the effects on the condition index based on different amounts of annual regular and preventative maintenance spending. In the latter approach, if travel time and reliability could be correlated to different condition index levels associated with a given level of spending, then regional economic costs could be derived from this information. This type of analysis has not been conducted in the Bay Area.

HERS

HERS is software designed to predict the financial investment required to achieve targeted performance levels for highways. The software also can be used to estimate roadway performance that would result given various investment levels, allowing the user to estimate what would happen to highway maintenance conditions under a given level of maintenance funding. HERS considers capital improvement projects related to both pavement (maintenance) and capacity expansion. The model was developed by the FHWA, and is designed to evaluate roads that are eligible for Federal highway funding.[40]

The model also predicts performance effects for highway users, such as traffic congestion (hours of delay), safety, operating speeds, fuel consumption, and air pollution. HERS provides for the establishment of minimum tolerable conditions for a variety of performance measures; and will prioritize investments in road

[40]This does not include minor collectors, or local roads in urban and rural areas.

improvements (including pavement resurfacing and reconstruction, alignment and drainage changes, road widening, and median and access controls) based on the cost of those improvements and the benefits that accrue from implementation. HERS also allows for the specification of financial policies, such as maximizing the net present value and minimizing costs.

The software includes benefit/cost analysis that can aid in economic analysis. However, it lacks easy access to varying the cost assumptions, which is important to maintain and update economic analysis unique to the MTC/ABAG (or other) study area.

TERM

FTA's Transit Economic Requirements Model, or TERM, was developed to estimate capital asset condition and performance for reports to Congress. The model is available to transit operators nationwide and is used to assess both the capital investment required to reach performance targets, as well as the level of performance given changes in investments.

TERM estimates asset condition from the age of the asset, and from statistical data on the relationship between age and condition. The model includes asset lifetimes by type of asset, recommended replacement, rehabilitation and rebuilding, and changes in likely conditions as the assets grow older. While the asset lives in TERM are not limits on actual use, they serve as general indicators for asset management.

A.2 PRICING

The following studies are presented to provide examples of detailed analysis of past and current pricing studies and best practices for conducting economic analysis related to pricing. Some examples include recent projects and studies conducted in San Francisco, New York, and Southern California to determine how pricing projects have impacted the regional economy. To date, the most aggressive cordon and congestion pricing implementations have been conducted outside the U.S. in London, Singapore, and Stockholm. Thus, this section provides some quantitative evidence of before-and-after economic impacts for these implemented projects. This list is not exhaustive, but the selected studies serve as reference documents because they support the framework presented in this paper.

***Bay Bridge Toll Evaluation: Final Report*, Elizabeth Deakin, Karen Trapenberg Frick, Robert Cervero, Alexander Skabardonis, Ian Barnes, Karla Kingsley, James Rubin, Jin Murakami, Javier Amaro, and Erik Jensen, Global Metropolitan Studies, University of California, November 2011**

In July 2010, the Bay Area Toll Authority (BATA) decided to increase the toll on the Bay Bridge during peak travel times. This report is based on the results of the actual implementation of peak-period tolling on the Bay Bridge in July 2010.

The authors conducted a before-and-after evaluation of the effects of peak-period pricing on the San Francisco-Oakland Bay Bridge. The study quantified congestion changes during weekday peak periods, and was able to isolate the net impacts of the Bay Bridge congestion pricing from other changes in the region. Authors noted that dynamic changes were "*…occurring in the Bay Area's urban economic structure, its transportation systems, and its consumer activities.*"

These time and mode shifts changes would manifest as economic impacts in a quantitative economic analysis. BATA volume data by time of day indicate that some Bay Bridge travelers have indeed shifted their trips out of the peak period, traveling just before the peak-period toll goes into effect or after the peak-period toll is over. The analysis suggests that significant shares of vehicles using the HOV lane during peak periods chose not to travel, switched to off-peak periods, or shifted to transit. Over one-half of the loss in traffic in the carpool lanes was estimated to be attributable to the introduction of an HOV lane toll, while less than 25 percent of the lost traffic appear to have switched over to BART, or was due to rising unemployment or gasoline prices.

Nevertheless, impacts from business formations, location shifts, retail sales figures, and property vacancy were studied using interviews, focus groups, and traveler surveys, which were qualitative in nature. Three types of business practices were considered in this study. First, inquiries were made about changes in travel assistance programs for employees and the extent to which congestion pricing was a factor. Second, changes in business hours of operation and customer incentives such as subsidized parking were explored. Finally, changes in scheduling of freight operations and deliveries were investigated.

Although the report could not provide quantitative evidence of its impact to the economy, it did provide insights into the relationship of pricing and the Bay Area economy. The implementation of this pricing scheme was limited in scope and scale, but provides before-and-after evidence of a change in travel behavior, and could be scaled up quickly once precedence has been set.

***San Francisco Mobility, Access, and Pricing Study (MAPS)*, San Francisco County Transportation Authority, presented to the Authority Board, December 2010**

This study of potential application of aggressive congestion pricing evaluated the feasibility of an areawide cordon pricing scheme and other pricing alternatives in the CBD in San Francisco. This analysis is now being followed up with a more in-depth analysis of a parking pricing and regulation approach. San Francisco's MAPS included a scenario analysis on the impacts of business activity due to an areawide cordon pricing scheme. The study estimated changes in business activity across the Bay Area region using a business activity relocation model linking accessibility to business activity by sector based on businesses' service orientation, output market power, labor dependency, and the sensitivity that businesses might relocate outside of San Francisco in response to a change in relative transportation costs and accessibility. As previously noted, the initial

results indicated a possible negative employment impact within San Francisco of up to two percent, with the repositioning of some business activity in the region. The overall finding, however, is that business and employment impacts would be broadly neutral to positive. This is because spending and output would increase substantially because of two reasons. First, based on a retail spending analysis, current monthly spending by transit users and pedestrians in the downtown area is comparable to or exceeds monthly spending by automobile travelers, due to the increased frequency of transit and walk trips, meaning increased economic output for the businesses within the pricing zone. Second, the positive employment impact of an initial external investment of $60 million to $100 million to implement the congestion pricing system would be significant, and would likely mitigate adverse impacts on business within the pricing zone.

***Congestion Pricing and Its Effect on Small Business*, Office of David Yassky, New York City Council Chair, Small Business Committee, July 2007**

Although not ultimately adopted because of political and other reasons, analyses from New York's proposed congestion pricing scheme determined that the reduction in congestion could cause a boost in productivity, which should have a positive impact on growth in the area. This study distinguished between the short-term business impacts and the longer-term impacts to businesses and the economy.

Previous implementations of cordon or area charges have been in cities with very high densities, had public transit mode shares of 50 percent or above, lower levels of automobile ownership and usage than in U.S. cities and highly centralized business districts with high population density. Thus, the literature that best reflects the measurement of economic impacts from pricing projects is from international cities with a selection of key resources below.

Coordination of Urban Road-User Charging Organizational Issues Final Report. The CURACAO Consortium including authors A. D. May and A. Koh, Institute for Transport Studies, University of Leeds, D. A. Blackledge and C. Humphrey, Transport and Travel Research, and M. Fioretto, ISIS, Rome, April 2009

This three-year study, conducted by a European consortium, studied the gap between the potential of urban road user charging and the progress of its actual implementation. The cities that did successfully implement congestion charging have all achieved reductions in traffic entering the charging zone in the range of 14 to 23 percent. This study showed that while the evidence remains limited, it is increasingly clear that the impacts of road user charging on the urban economy are likely to be small and, in particular, much smaller than the business community predicts. In addition, despite the difficulty in evaluating the impact of an urban road user charging scheme on an urban economy, this study could find no clear evidence of negative effects that can be generally related to road charging implementation.

London is home to a well-studied congestion charging scheme that is an area licensing system, where vehicles are charged when entering a specific zone during specific time periods. London's downtown economy also has experienced benefits since the pricing program has been implemented; businesses within the charged zone are growing faster than businesses outside the zone. Other studies have found evidence of higher spending levels in Central London by transit users and pedestrians as compared with automobile drivers.

Stockholm, which first imposed congestion pricing as a trial and later reintroduced it permanently in 2007. The program also has resulted in positive economic impacts: businesses within the charged zone have seen an increase in sales of 5 percent, in part, because the charging system requires drivers to pay to both enter and exit the zone, giving Stockholm residents an incentive to shop locally within the charged zone rather than drive out to the suburbs. Prior to the implementation of the congestion charge, the area within the charged zone was heavily congested. Once the charge was in place, businesses found that they were able to make 25 percent more deliveries during charged hours as a result of congestion reduction benefits. Thus, despite the increased charge, meeting on-time delivery and reducing fuel and idling costs brought a net positive economic benefit for many businesses.

Singapore has one of the most complex and demand-responsive road pricing system in the world to date. Their Area Licensing Scheme (ALS) was the precursor to today's modern-day Electronic Road Pricing (ERP). Vehicles entering a congested "restricted zone" along 28 entry points during the pricing period were required to display a pre-purchased daily or monthly windshield license. The licenses were sold at retail outlets (banks, stores, service stations) and at roadside booths. Violators were identified at entry points by roadside enforcers and citations were sent to vehicle owners by mail.

The current day ERP scheme has a sophisticated way to vary charges for motorists entering the CBD and expressways/outer ring roads. Vehicles are charged automatically on an electronic card, which is inserted in an in-vehicle unit each time the vehicle crosses a gantry. If the charge cannot be deducted from the card, either because it is not properly inserted or because it does not have sufficient credit, a fine is issued to the vehicle owner. Since charges vary with vehicle type, time of day and location of the gantry, and are only debited per passage, they incorporate a fair degree of differentiation.

A.3 GOODS MOVEMENT

The following studies are cited as examples of detailed analysis of the economic impact of goods movement policies and best practices for conducting economic analysis. Several describe the underlying economic theory that explains the relationship between economic performance and freight and goods movement. Others contain useful California and Bay Area economic data and tools. The list

is not exhaustive, but provides a starting point to build the analytical approach recommended in this paper.

Regional Goods Movement Study for the San Francisco Bay Area Final Summary Report, **prepared for the MTC by Cambridge Systematics, Inc., December 2004**

This study showcased how goods movement industries play a critical role in the Bay Area's economy by determining the economic significance of goods movement in the Bay Area, and described the economic implications of policy decisions that affect goods movement. It also found that land use and real estate market trends in the Bay Area are reducing the supply of land and building space for goods movement businesses in the central bayside areas of the region, while the demand for goods movement services continues to grow in the central areas. The trends raise important economic, transportation, and land use policy questions for the Bay Area; and will affect the efficiency of goods movement and freight transportation throughout the region. It provided guidance to MTC and ABAG on appropriate investment strategies and policies for improving regional goods movement in MTC's 2030 RTP.

Goods Movement/Land Use Project: Understanding Local Land-Use Decisions on Goods Movement Cost and Efficiency in the Bay Area, Final Summary Report**, Hausrath Economics Group, Cambridge Systematics, Inc., and the Tioga Group, Inc., prepared for the MTC, December 2008**

This report furthers the Regional Goods Movement Study conducted by MTC in 2004 to identify the cumulative implications of local land use decisions for the efficiency and cost of regional goods movement and to understand the locations for goods movements businesses along key corridors. The first phase identified and mapped where industrial land uses suitable for goods movement businesses are located along key regional corridors and the locations at risk because land use plans and policies allow or encourage transition to new uses there. The second phase completed the land supply analysis and then included demand analyses to provide an understanding of goods movement businesses/industries and impact analyses to assess the regional implications of current trends.

SCAG Comprehensive Regional Goods Movement Plan and Implementation Strategy, **Led by Cambridge Systematics, Inc., and anticipated completion by December 2012**

Through its 2012 to 2035 RTP/SCS, SCAG identifies nearly $50 billion in needed investments for goods movement, including more than $8 billion in near-term initiatives. This study is developing a comprehensive and fully-integrated regional goods movement plan for Southern California, including an implementation strategy. The overall purpose of the project is to develop a comprehensive regional goods movement plan for Southern California that refines the goods movement portion of the agency's 2012 RTP/SCS. The study is developing a prioritized project list and phasing plan that serves to enhance the

goods movement capabilities of the SCAG region, and optimize transportation system performance as efficiently as possible.

***The Local and Regional Economic Impacts of the San Francisco International Airport*, Martin Associates, June 2009**

The San Francisco International Airport (SFO) conducted an analysis in both 2005 and 2009 to measure the economic impacts generated by passenger and air freight activity at SFO. The base year of the analysis is fiscal year 2008. The economic impacts created by the airport were measured in terms of jobs, personal income, state and local taxes, and revenue generated directly by airport activity, including the impact of visitors to the Bay Area who used SFO. This type of study is periodically conducted by large facilities, such as ports (e.g., Port of Oakland); larger commercial airports with air cargo (e.g., SFO, Oakland International Airport (OAK), and Mineta San Jose International Airport (SJC)); and intermodal facilities. Although these are typically studies conducted for promoting economic development, many of the data and analyses can be included in a regional economic impact study as well.

A.4 HOUSING POLICY AND ACCESS TO LABOR

Annotated Bibliography of Past Studies

The following studies are presented to provide examples of detailed analysis of past and current housing policies and best practices for conducting economic analysis. Some examples describe the underlying economic theory that explains links between economic performance and the supply and location of housing. Others are California or Bay Area studies with useful economic data and tools presented. This list is not exhaustive, but we selected the studies as reference documents because they support the framework presented in this paper.

Building California's Future, An Economic and Fiscal Analysis of Housing Construction in the Golden State, Maya Brennan, Keith Wardrip, Center for Housing Policy, Washington, D.C., July 2010

This report is based on research conducted by Blue Sky Consulting Group, summarized in *Analysis of the Fiscal and Economic Effects of New Housing Construction in California* by Matthew Newman. The report found that, despite the economic downturn, new housing construction has had positive economic and fiscal effects in California. Economic estimates were created using the IMPLAN I/O model, based on the cost of materials and labor to construct homes. The report is an example of communicating economic impacts, and provides methodological detail useful in future *Plan Bay Area* update analysis.

Economic Geography, Jobs, and Regulations: The Value of Land and Housing, Nils Kok, Paavo Monkkonen, John M. Quigley, Berkeley Program for Housing and Urban Policy, February 2011

This paper presents quantitative research based on more than 7,000 land transactions in the San Francisco Bay Area from 1990 to 2009. The data included physical access of sites, the topographical and demographic characteristics, prices of vacant land, other local services, and regulatory restrictions on commercial and residential development. The paper relates variations in land prices based on these variables to the prices paid by consumers for housing in the Bay Area. The paper presents useful research regarding issues affecting housing development in the Bay Area, which would support future economic analysis of updates to *Plan Bay Area*.

Fueling the Fire: Information Technology and Housing Price Appreciation in the San Francisco Bay Area and the Twin Cities, Karen Chapple, John V. Thomas, Dena Belzer, Gerald Autler, Housing Policy Debate, Vol. 15, Issue 2, 2004

This article presents the Bay Area as a case study to examine how the variation in housing price appreciation determines the role of intra-metropolitan sectoral location patterns that shape local housing markets. The research determines key drivers of housing market differences using models based on livability indicators at the zip code level, as well as economic indicators based on city-level commute sheds. The findings suggest that start-up firms in information-intensive industries help shape housing markets in the Bay Area. The paper presents a methodology and data for determining commute areas that could be used to develop economic models of access to labor in the Bay Area. The paper also contains useful background information regarding the impact of specific industry sectors on regional housing markets.

Increasing Returns and Economic Geography, Paul Krugman, The Journal of Political Economy, Vol. 99, No. 3, June 1991, pp. 483-499

This paper presents a theoretical model for how areas develop into what is known to planners and urbanists as agglomeration economies. The author posited that economic benefits arise from five effects of higher residential and industrial/commercial densities: access to labor, industry matching, sharing, knowledge spillovers, and competition. This article provides theoretical underpinning of economic analysis of agglomeration

Jobs-Housing Balance Revisited: Trends and Impacts in the San Francisco Bay Area, Robert Cervero, Journal of the American Planning Association, 62:4, 492-511, 1996

This article presents data regarding the co-location of residents and jobs in the Bay Area, which revealed general worsening of jobs-housing balance in job-rich cities, and little association between jobs-housing balance and self-containment. The author argues that reducing barriers to residential mobility and housing production would allow more housing and jobs to co-locate. The article provides

a good summary of empirical work analyzing trends in commuting, and the effects of housing price and supply on the location choices of workers. The paper provides a template for analyzing work travel data related to housing locations.

***Jobs-Housing Connection Strategy: 2012 to 2040 Regional Transportation Plan,* ABAG, Oakland, California, May 2012**

This report serves as the land-use element of the Draft Preferred Scenario for the Bay Area's first SCS mandated by SB 375. Regional agencies, local governments, county transportation agencies, transit providers, and community-based organizations provided partnered to develop the strategy to integrate priorities across housing, economic development, transportation, and land conservation policies. The document includes methodologies for creating future job and population growth scenarios in each community in the Bay Area, as well as future forecasts of growth.

Priced Out: Persistence of the Workforce Housing Gap in the San Francisco Bay Area, Urban Land Institute, 2009

This report indicates that housing in the Bay Area has been persistently unaffordable for residents despite the recent economic and housing market downturn. The report highlighted current trends suggesting that by 2025 housing production will leave unmet demand for at least 6,000 housing units appropriate for workforce households. The report provides data and methodology useful for implementing and presenting future analysis of SCS/RTP housing scenarios.

Restricting New Infrastructure: Bad for Business in California? Karen Chapple, Carrie Makarewicz, Access, Number 36, Spring 2010

This article is written as a response to criticisms that SB 375 would restrict employment growth by limiting the ability of firms to locate outside dense urban areas, particularly where more transportation infrastructure would be needed. The authors' research indicates that available infrastructure is not the only factor driving job growth and location choice of firms; other important factors include access to qualified labor, new housing, and other city amenities. The article provides summaries of data sources and methodologies for identifying industries that contribute the most to economic growth in the region, and the infrastructure demands of those firms.

Triumph of the City: How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier. Edward Glaeser, Penguin New York, New York, 2011

This book presents evidence that cities are the healthiest, greenest, and richest (both cultural and economic) places to live. The author's message focuses on how cities can mitigate the emissions leading to global warming. A constant message supporting prosperity of cities is that people will be attracted to a city based on the availability of new housing construction. Restrictive places, such as

New York City, coastal California, and Paris, have a tight housing supply with high prices, leading middle-class people to move to more sprawling development areas. Other features of a region, such as poverty, crime, traffic congestion, quality of schools, and cultural amenities, are similarly important in impacting the increase or decrease of the area's population. The book provides summaries of theoretical underpinnings for future SCS/RTP economic analysis, and outlines key issues connecting housing policy and access to labor.

Evaluating the Effects of Projected Job Growth on Housing Demand, Karen Chapple, Technical Memorandum to ABAG, August 2012

This memorandum explores how the wages expected to accompany projected job growth in the Bay Area might impact household incomes. It then examined what type of housing at what affordability levels might be needed to house this future workforce. The first section describes the translation from the Draft *Plan Bay Area* job projections into future demand for affordable housing. The second section analyzes how housing costs might change in the future. http://www.onebayarea.org/pdf/KC_Effects_of_Projected_Job_Growth_on_Housing.pdf.

Joint Venture Silicon Valley (2012) Index of Silicon Valley, San Jose, CA

Published annually, this report chronicles recent economic growth in Silicon Valley through analysis of venture capital spending, patent registrations, new firm formation, and IPOs. The analysis covered a range of business and social indicators, including sector specific industry detail, changes in public sector finance, and changes in household incomes. The report presents detailed data in relation to regional trends and how these trends will affect future growth in Silicon Valley.

Bay Area Job Growth to 2040: Projections and Analysis. Stephen Levy, prepared for Association of Bay Area Economics, Palo Alto, CA, August 2012, *http://www.onebayarea.org/pdf/3-9-12/CCSCE_Bay_Area_Job_Growth_to_2040.pdf*

This memorandum presents regional job projections to the year 2040. The projections were intended to assist ABAG staff in preparing population and household projections for *Plan Bay Area*. The report focuses on the job projections prepared by Center for Continuing Study of the California Economy; and includes a summary of the methodology, a description of the projections and an explanation of past, current, and projected job growth in the region.

Regional Policy Background Paper: Housing the Workforce in the Bay Area, ABAG, October 3, 2012

This paper addresses the region's future housing needs. The paper describes recent trends and challenges in housing production across the Bay Area; assesses projected housing growth in future decades, including opportunities to better connect homes and jobs and anticipated obstacles to meeting demand across income categories; and presents for discussion strategies to increase housing production and affordability.

Overcoming Mismatch: Beyond Dispersal, Mobility, and Development Strategies, Karen Chapple, Journal of the American Planning Association 72:3, 322-336, 2006

Since the 1960s, John Kain's theory of spatial mismatch has influenced policy responses to the poor employment prospects of low-income and minority residents of inner cities by aiming to connect them with suburban jobs. This literature review examines this policy legacy using what we now know about disadvantaged jobseekers' employment searches. Recent evaluations of poverty deconcentration and employment accessibility programs show that these programs have failed to improve employment outcomes significantly. Using evidence from studies of job search and job training programs, she shows that local activity patterns do shape employment chances. Planners trying to improve employment outcomes for the disadvantaged should focus on policies that will provide them with opportunities to interact with a diverse social network and meet workforce intermediaries capable of linking them with jobs.

Are the High Fliers Pricing Themselves out of the Market: The Impact of Housing Cost on Domestic Migration Rates in U.S. Metropolitan Areas, Barry Bluestone, Mary Huff Stevenson, Russell Williams, Presentation to the Urban Affairs Association Annual Meeting, Chicago, Illinois, March 2009

In a general equilibrium model, the amenities-neutral real cost of living should equalize across regions. However, barriers to migration may prevent rapid market adjustment. Using data for 347 U.S. metropolitan areas and controlling for employment growth, climate, and crime, the authors find that the impact of housing costs on net domestic migration is non-linear. Net domestic migration rates are positively correlated with housing costs for 90 percent of these metropolitan areas, but negatively correlated for the 10 percent with the highest housing costs. The authors find that an extraordinarily high cost housing market has a substantial adverse effect on a region's ability to retain population and attract new residents, even where there is employment growth.

Bay Area Burden: Examining the Costs and Impacts of Housing and Transportation on Bay Area Residents, Their Neighborhoods, and the Environment, Urban Land Institute, 2009

This is a comprehensive analysis of the cost of place in nine counties located throughout the San Francisco region by examining the costs and impacts of housing and transportation on Bay Area residents, their neighborhoods, and the environment. The high combined costs of housing and transportation leave many Bay Area households with insufficient remaining income to comfortably meet their basic needs. This underscores the importance of broadening our understanding of housing affordability to consider the combined costs of housing and transportation, as well as the impacts of longer commutes on the environment and quality of life. This report exposes the complexity of the interaction of housing and transportation choices, as well as expenditures, and the unintended consequences on the natural environment when they work at cross purposes. The report also highlights the importance of location efficiency –

the proximity of housing to transportation hubs, employment, and retail centers – as a driver of both affordability and environmental sustainability.

Urbanization, Agglomeration, and Economic Development, John M. Quigley, in A. Michael Spence, et al., eds., Urbanization and Growth, Washington, D.C.: World Bank Press, 2008: 115-132

This paper reviews the linkages between urbanization and economic development. It articulates the relationship between urban density and potential increases in productivity – through specialization, complementarities in production, through the diffusion of knowledge and mimicry, and simply through size and scale. The factors limiting the efficient sizes of cities are analyzed. The paper reviews empirical knowledge – from underdeveloped countries as well as high-income industrial societies – about the importance and magnitudes of these productivity gains. The analysis documents the close link between gains in economic efficiency and the urbanization of populations in most parts of the world.

A.5 MARKET FEASIBILITY OF PRIORITY DEVELOPMENT AREAS

Annotated Bibliography of Past Studies

The following studies are presented to provide past and current examples of national development trends for TODs and the demographic changes that support denser, more walkable communities. While some trends are likely temporary, the latest 2010 U.S. Census suggests that many households in the Bay Area have adapted lifestyles that include lower car ownership, more transit and bicycle use, and minimizing commute distance. This annotated bibliography includes brief summaries of recently launched projects to promote these PDA-friendly lifestyle changes, which if successful, should improve PDA development in the next *Plan Bay Area* update.

Planned Priority Development Area Assessment – Readiness, ABAG, September 7, 2010
ABAG and MTC requested local jurisdictions with planned PDAs throughout the Bay Area to complete a survey to determine PDA readiness for development. Regional agency staff collected the data and formulated measures of development readiness and feasibility around three main topic areas with a range of three to four metrics for each topic. 1) Planning and Entitlement: Metrics included the extent of planning completed for the PDA, the average processing time for project approvals, typical development fees, and entitlement streamlining policies in place; 2) Investment Attractiveness: Metrics included number of pipeline and under-construction projects, entitled and built units within versus outside the PDA, the expected effect of vacancies and foreclosures on development, and infill development potential based on the investment-to-

land ratio; and 3) Community Support: Metrics included level of stakeholder involvement and support for TOD, elected official support for plan adoption, approved versus rejected TOD projects in the PDA, and unresolved community concerns. The full description of this research and its findings are reported in a memorandum to the Regional Advisory Working Group, September 7, 2010. http://apps.mtc.ca.gov/meeting_packet_documents/agenda_1533/3_PDA_Assessment_Sept_2010.pdf

Choosing Where We Live: Attracting Residents to Transit-Oriented Neighborhoods, MTC, 2009

To support the development of successful TODs in the Bay Area, CS completed a year-long research effort to examine what public services, infrastructure, and amenities attract home-seekers to TODs. The market research involved a set of focus groups to elicit qualitative insights from Bay Area residents about their moving/home selection process, a new mover survey of 911 households, a market segmentation to identify underlying attitudinal dimensions (key factors) by combining 35 attitudinal statements and applied structural equations modeling (SEM) to link each factor with a set of related socioeconomic characteristics and follow-up qualitative research. The result was the definition of eight market segments, each with different attributes and different levels of amenability to living in housing with various characteristics. The research shows five of the eight market segments are the most easily attracted to TODs: Transit Preferring, Urban DINKs, Young Brainiacs, Mellow Couples, and Ambitious Urbanites. The market research and findings are oriented toward assisting elected officials, public agency professionals, community advocates, developers, and others in creating policies and approaches to develop high quality TODs that successfully attract residents.

Retailers Race toward City Locations and Smaller Stores: The Homebuilding Bust Has Upended National Chains' Strategy of Growing in the Distant Suburbs, Philip Langdon, Better Cities and Towns, July to August 2012, Volume 1, Number 5

The article provides examples of major suburban retailers adapting their outlets to urban markets. Their efforts to co-locate as infill developments include multistory layouts, smaller footprints, parking on the roof or in the basement, and lower ceilings (occupying older buildings). Prior to the collapse of American homebuilding that began in 2007 and the global financial crisis of 2008, major retail developers would locate on cheap land on the edge of expanding suburban and ex-urban sprawl. After 2008, the market for these retailers began shifting to urban neighborhoods, as many new suburban subdivisions failed and lost population and/or households lost income. Example provided include smaller-format, supermarket-size City Targets (one located in San Francisco); many of Kohl's new stores are one-third smaller than its previous typical size (about 60,000 square feet); and Wal-Mart's 35,000- to 40,000-square foot neighborhood grocery stores.

Investment-Ready Places: A Field Guide to Community Building in the New American Frontier, Version 1.0, Kevin Lavelle, James Michael, Joseph Nickol, and Atul Sharma, www.street-sense.org@streetsense

This booklet presents a three-tiered typology of American settlements: gateway cities, suburban settlements, and mid-tier towns and cities (or what the authors call the New American Frontier). This last type provides Investment Ready Places (IRP). The authors recommend strategies that can maximize the development potential for IRPs, and provide a tool kit to help undertake projects in IRPs.

Moving to Work: Great Communities Collaborative's Regional Policy and Planning Strategy
http://www.reconnectingamerica.org/what-we-do/movingtowork/

The Great Communities Collaborative (GCC) was formed in 2006 to work towards a future where mixed-income, transit-oriented communities would become prevalent in the Bay Area. Currently, there are seven core partners: Greenbelt Alliance, Non-Profit Housing Association of Northern California, TransForm, Urban Habitat, Reconnecting America, the San Francisco Foundation, and the Silicon Valley Community Foundation. The Regional Policy and Planning Strategy was presented in a document that identifies a five-year smart growth plan (2011 to 2016). The coalition's main goal for this project is to link low-income workers, job support services, trainings, and employers to the Bay Area's transit system. The project has both short- and long-term outcomes of which some focus on the analysis and support of TOD efforts at the local and regional level. These include identifying industries and places of opportunity, and assessing their relation to transit and analyzing commuting patterns, and transportation and housing costs of low-income workers. The project also will ensure that the identified strategies inform the Regional Economic Prosperity Plan of the U.S. Department of Housing and Urban Development Sustainable Communities Grant.

Grand Boulevard Initiative – Economic, and Housing Opportunity Assessment, Grand Boulevard Initiative Task Force, ongoing

The Grand Boulevard Initiative is a regional collaboration dedicated to the revitalization of the El Camino Real corridor, as it runs through San Mateo and Santa Clara Counties. The corridor includes 13 PDAs (12 city-nominated PDAs and one nominated by City/County Association of Governments of San Mateo County). The Initiative is directed by representatives of Caltrans, ABAG, MTC, Santa Clara VTA, City/County Association of Governments in San Mateo County (C/CAG), San Mateo County Economic Development Association (SAMCEDA), Joint Venture: Silicon Valley Network, and SamTrans. Phase I of the study measured the fiscal benefits of additional housing, employment, and retail spending growth projections. Phase I also included building prototypes and renderings to illustrate future development. Phase II of the study conducts

case studies of development scenarios, including a pro forma analysis, and assessment of barriers to investment. Phase II also includes an implementation guide that provides next steps to achieving the vision for the corridor. These reports can provide important framework for future PDA development assessments.

http://www.grandboulevard.net/images/stories/documents/echo_final%20report_12-20-2010.pdf

http://www.grandboulevard.net/images/stories/GBI-Documents/ECHOII/echoii_final.pdf

Building on Our Assets – Economic Development and Job Creation in the East Bay, East Bay Economic Development Alliance, 2011

This plan presented a qualitative analysis of economic development opportunities in the East Bay region (Alameda and Contra Costa counties). It was supported by quantitative technical memoranda with detailed economic analysis methods and results. In particular, one memorandum described the role, condition, and future needs of the East Bay's physical infrastructure related to goods movement, commuter movement, commuter access, and land use. Another provided an analysis of the land use patterns in the East Bay Region, including trends in land use and availability, by use category and subcounty regions. The plan did not directly address financial feasibility of neighborhood-level development.

International Boulevard TOD Plan, City of Oakland (California), 2011

This plan assessed opportunities for developing TOD projects along International Boulevard, identified strategies for realizing TOD projects in these areas, and developed a menu of options for addressing challenges to development. The plan assesses demand for office and residential uses on the Boulevard through discussion of trends in rental rates, land cost, and construction costs. Subarea plans presented qualitative visions of neighborhood-level economic growth based on regional trends, but do not quantify development potential through analysis of development restrictions or pro forma analysis.

West Oakland Transit Village Action Study, Bay Area Rapid Transit, Oakland Housing Authority, and the City of Oakland, 2005

This plan identified opportunities for development in the area around the West Oakland BART Station. Based on regional economic trends for commercial and residential real estate demand, the plan estimated that more than 2,000 residential units and 50,000 square feet of new commercial space were expected to develop in the area. The plan inventoried existing and planned developable area by expected use types. The plan included three analyses of development potential, including two residential buildings and one parking structure. The analyses used a pro forma analysis method that incorporated restrictions on

development with expected market demand. While the market trend assumptions are outdated, the document provides an example of a Bay Area pro forma analysis.

Transit Area Plans, 2005 to 2011

MTC and BART provide links to more than 40 station area or PDA plans between 2001 and 2011. These plans have included general neighborhood or specific plans, as well as station access, and construction feasibility plans. The neighborhood or specific plans typically include a market assessment, which estimates demand for generic commercial and residential development types near BART or other transit stations and along transit corridors. Where included, the market assessments are based on quantitative trends in land use and socioeconomics, such as population age, employment, incomes, and rental prices. The market assessments also included assessments of existing vacancies and key tenants in station areas as part of a discussion of land supply. With limited exceptions, these plans have not typically included development pro forma analysis, nor other detailed estimates of development potential. Some of these planning efforts incorporate land use regulation or zoning changes, while others do not. While the market assessments are largely based on outdated data and trends, the reports may be used for planning context in future neighborhood development studies. Examples of station area or PDA reports and plans include:

- **Lawrence Station Area Plan, City of Sunnyvale (California), 2011.** This plan analyzed current and future development potential in the area around the existing Caltrain Station near Lawrence Expressway. The market assessment provided quantitative analysis of existing land uses, development density, recent and planned development, and trends in the residential, retail, and office space demand. The plan assessed the financial feasibility of TOD types in the station area through a pro forma analysis of potential development. This study is one of a limited number of station area plans with a high level of detail on development feasibility.
- **Lake Merritt BART Station Final Summary Report, BART, 2006.** This study developed a community-based vision for the station area, based on an existing conditions analysis, a market analysis, a station access survey, a land use conceptual design study, and traffic analysis. The economic analysis is based on demographic trends, real estate sales trends, and a land use opportunities analysis. The results of the analysis provide qualitative estimates of future development markets. The report indicates that a future study would analyze the financial feasibility of case study projects; however, no such study was available.
- **Milpitas Transit Area Specific Plan, City of Milpitas, 2011.** This plan for the redevelopment of a 440-acre area in the southern portion of Milpitas included industrial uses near the Great Mall shopping center. The Draft Preferred Plan proposed redevelopment of this area with 7,110 multifamily

dwelling units; 994,000 square feet of office space; 340 hotel rooms; and 287,000 square feet of retail space. The study included details on a Transit Area Development Impact Fee, which included estimates of available development area and associated infrastructure costs. The methodology limited development potential to 90 percent of the midpoint of allowable density.

B. Linking Economic Development, Transportation Planning, and Land Use Planning

B.1 SUMMARY OF REGIONAL BEST PRACTICES

Members of the Bay Area Business Coalition were interested in examples of other regions that have incorporated economic performance-based or other analytical methods to link economic development and transportation and land use planning. The eight regions identified in the best practices review are listed in Table B.1. The findings lead to three recommended actions to implement economic analysis procedures into future RTP/SCS efforts. Each recommended action is described, and agencies with specific examples related to the topic are noted.

Table B.1 Summary of Findings for Best Practices

Best Practice Area	Applicability to Bay Area	Agency Examples
Best Practice 1. Build Collaborative Partnerships	This best practice relates to the efforts by the Bay Area JPC's assessment of the regional economy. Members of the JPC – the Bay Area Business Coalition and other business stakeholders – could play key roles in developing and evaluating future regional plans.	• Puget Sound Regional Council (PSRC) • New York Regional Plan Association (RPA) • Los Angeles County Economic Development Corporation (LA EDC) • Kansas Department of Transportation (DOT)
Best Practice 2. Create Indicators of Sustainable Competitiveness	As a next step stemming from the JPC's assessment of the regional economy and under JPC leadership, the region could develop indicators that measure the sustainable competitiveness of the region's economy. These indicators could be integrated into an ongoing evaluation process through the RTP/SCS.	• San Diego Regional Economic Development Corporation (EDC)
Best Practice 3. Integrate Economic Development into Project Prioritization and Funding Decisions	Best practices suggest benefits from a project prioritization process that uses project-level evaluations with economic impact or development to evaluate projects submitted for the RTP. Transportation investment evaluation measures could include the number of jobs created per project, whether a project might have the potential to attract increased future industry and employment, and whether projects are located within key economic development areas (i.e., priority development areas).	• Puget Sound Regional Council (PSRC) • Georgia Department of Transportation (DOT) • Kansas Department of Transportation (DOT) • Wisconsin Department of Transportation (DOT)

B.2 BEST PRACTICE 1. BUILD COLLABORATIVE PARTNERSHIPS

Introduction

One of the effective tactics for building regional cooperation among a diverse coalition of stakeholders involves collaborations beyond city, county, and sometimes state geographical borders. Planning activities that may create conflicts at the local level can be more acceptable if the objectives are set in a broad context illustrating regional goals and benefits. Emphasizing cooperation among economic development organizations, universities, governments, and community and business leaders builds momentum by focusing attention on the common goals and priorities. For example, a municipal government may oppose increased height restrictions around their transit station due to neighborhood opposition. However, highlighting regional support and financing available for transit-oriented developments (TOD) may encourage local stakeholders to consider future development that supports regional goals.

Examples

All eight regions highlighted in this best practices report were able to recruit a set of influential stakeholders to embark on efforts to successfully apply economic assessment to transportation and land use planning. These MPOs, state DOTs, and economic development corporation had an interest in maintaining or expanding their regional, national, or global competitiveness; and/or diversifying their region's industry mix. Their interests also intersected with some of the same objectives embraced by other stakeholders, such as environmental and socioeconomic equality advocates. Economic, environmental, and equity advocates each promote a better quality of life for their regions, but each may define it differently. A focus on economic growth, for example, places a higher priority on ensuring a better match between sufficient market rate housing for workers who have jobs in the region's most competitive industries. Alternatively, advocates for greater socioeconomic equity regard market rate housing as potentially competing for scarce land that could accommodate affordable housing and easier access for low-income residents to jobs. Ensuring a healthy region requires balancing these three perspectives – economic growth, environmental sustainability, and equity – and providing a planning process that allows the public to understand the tradeoffs between them. The challenge of building a coalition, therefore, requires understanding of the shared goals and potential conflicts.

The PSRC example represents the engagement of a collaborative partnership to support long-term economic prosperity that began in 2004 and has grown to be one of three critical elements (equal with transportation and land use) in the

long-range planning process. PSRC's Prosperity Partnership was launched in 2004 as a coalition of more than 300 government, business, higher education, labor, and nonprofit organizations from King, Kitsap, Pierce, and Snohomish Counties with the charge to develop and implement a common economic strategy with a goal of long-term economic prosperity for the central Puget Sound region. The Partnership even launched a higher education task force to ensure that more Washington residents received Bachelor's degrees by providing them opportunities and reducing the barriers of increasing tuition (e.g., pledges from businesses like Microsoft and Boeing to pledge money to defray the cost of tuition). The result would be a higher educated workforce to enter the information economy.

The latest Regional Economic Strategy, published in July 2012, integrates PSRC's transportation and growth planning efforts, strengthening the economic link between transportation investments and land use plans. Although the Partnership is now consensus-based, it was clear at the outset over 10 years ago that a few key individuals had already begun crafting a vision for the region that at the time did not exist. PSRC helped to capitalize on this vision and build a larger coalition to examine the role of economics in regional planning. Once the membership was identified, PSRC could provide the structure and the means for making recommendations through the RTP process.

Some regions like those supported by the New York RPA suggest a less formalized approach, where economic analysis forums are organized through the MPO, but take place outside of the RTP process. For instance, the Empire State Transportation Alliance in New York is an independent group of the Region's civic, business, transportation, and environmental leaders coordinated through the RPA. The Alliance and the RPA advocate on behalf of transportation investments. They do not play an official role in the RTP development process, but they do conduct outreach campaigns for specific projects and investments.

Another way to convene a diverse set of stakeholders around economic development and transportation and land use planning is through the initiation of a strong economic development agency. The LA EDC received foundation support from the Morgan Family Foundation and started with a survey of more than 5,000 businesses to inquire on the health and concerns of industry. This led to a cluster analysis to determine key industries, a series of focus groups to confirm needs, opportunities and growth potential, and then a series of 26 public workshops to solicit input on the plan. This process ultimately convened more than 1,080 participants; many drawn from the participants at the 26 public forums to contribute to the LA EDC Strategic Plan. This led to a process that was not developed through a constitution, but through public outreach and consensus. The results provided high-level input to the RTP developed by the Southern California Association of Governments (SCAG).

Although an agency may establish or catalyze the *formation* of a regular forum for business leader participation, in many of the best practice case studies, the

agency's role is even more important in maintaining momentum for the group during the multiyear RTP planning process. In Kansas, the Transportation Task Force (T-Link) was established by the governor as the key connection for policy recommendations in the planning process to go to the legislature. The T-Link Blue Ribbon Panel (local officials, construction industry, etc.) was instated to add economic analysis to the project selection process. In that process, Kansas DOT solicited input from chambers of commerce, cities, and counties (staff and elected officials); five MPOs (staff and board); transit; aviation; rail; contractors; and motor carriers to develop performance criteria. Although the e-mail distribution list for this process included more than 2,000 names, it was the first time this set of relevant actors was included in one distribution list. The inclusivity of all interested parties from the T-Link Blue Ribbon Panel (rather than a more exclusive closed list) symbolized transparency and was cited as a key reason the engagement was viewed as successful. Maintaining this open invitation throughout the long-range planning effort provided Kansas DOT a means to legitimize the final funding recommendations for projects included in the plan.

B.3 BEST PRACTICE 2. CREATE INDICATORS OF SUSTAINABLE COMPETITIVENESS

Introduction

Some regional organizations have created indicators of sustainable economic competitiveness that are used to measure and track policy objectives over time. They are benchmark metrics defined by regional partnerships to highlight factors that contribute to a sustainable and competitive region. For example, if one regional policy objective is to improve air quality, annually reporting on capital infrastructure investments that impact environmental quality, such as number of days a region does not meet the U.S. Environmental Protection Agency (EPA) standards, can confirm whether the region is moving in the right direction to achieve its objective.

Examples

The San Diego region organized its list of indicators around three elements – economics, environment, and equity – and their associated metrics:

- **Economy.** Standard of living, innovation, educational attainment, private investment as a share of regional product and government capital facilities investment on infrastructure necessary for economic development;
- **Environment.** Air and water quality, and governmental capital investments on infrastructure that impact environmental quality; and
- **Equity.** The distribution of income, housing affordability, basic education, transportation, and governmental capital facilities investments on public transportation.

Because many complex external variables, such as demographic shifts and the larger macro-economy at the federal and international levels, can influence local and regional land use and transportation planning, a one-year snapshot analysis of an indicator may not reveal the relationship between planning interventions and outcomes. However, tracking both indicators and planning outcomes over time may, in the long term, establish causality between planning interventions and outcomes. As an extreme example, in developing a cordon pricing scheme around a congested city center, the effects on businesses within and surrounding the cordon would be tracked before and after implementation. If the timing of implementing the pricing scheme correlates with a global recession, the impacts on the central business may be more affected by the global recession than the congestion charge. However, measuring the business effects over a longer period of time may reveal insights about how businesses react to this planning intervention. Other sections of this document provide ways to measure the outcomes from different types of planning interventions MTC and ABAG would likely consider in the next RTP/SCS.

The San Diego Regional EDC is a national model in using indicators of sustainable competitiveness, as described above. In conjunction with the San Diego Association of Governments (SANDAG), San Diego Regional EDC conducted an initial study in 2001 to evaluate how San Diego compared to 18 other regional markets in the U.S. using a set of indicators that covered the "three E's" (economy, environment, and equity) principles. A blue-ribbon advisory committee of civic and business association leaders, local elected officials, public facility providers and operators, education and workforce training providers oversaw development of the study. One of the study's outcomes was a set of indicators that measured the region's competitiveness against similar regional markets in the United States. These indicators allowed the region to identify areas that need improvement for it to be more competitive in the U.S. market. In addition, the process, data, and analysis used to develop these indicators offered the region and its stakeholders a common language from which to understand and communicate regional economic priorities.

A key conclusion of the study was the need for periodic reevaluation of how San Diego is faring against its rival regions. Some of the findings were surprising: for instance, the EDC hypothesized that San Diego was a highly competitive region nationally, with the high cost of housing being the only pitfall for attracting new talent. The indicators showed, however, that San Diego had emerged in the middle of a list of competitor cities – a fact that business leaders knew, but elected officials did not. The cost of housing did lower San Diego's standing amongst its competitor regions, but the region's long commute times were found to be a much bigger issue. These results were able to spur discussion and keep issues, such as affordable housing and transportation needs, on the table. They also served to support the one-half cent sales tax in San Diego that has funded a variety of transportation improvements.

B.4 BEST PRACTICE 3. INTEGRATE ECONOMIC FACTORS INTO PROJECT PRIORITIZATION AND FUNDING DECISIONS

Introduction

To inform project prioritization, economic analyses take the direct benefits from alternative transportation projects or bundles of projects; and transform them into changes in employment, income, and output (i.e., gross state or regional product). This transformation may seem like alchemy because these direct benefits, such as faster or more reliable travel time; fewer accidents and access to more workers, suppliers, or customers for businesses are weighted by the volumes of travel, the value added and productivity of the affected industries, and the competitiveness of the state's businesses and workforce compared to their counterparts in other states and, increasingly, throughout the world. When economic analysis takes all these complex interactions into account, the results may rank alternative investments differently than a ranking that applies only the direct benefits.

Examples

Economic analysis may be used for project prioritization in combination with more traditional performance measures, such as cost effectiveness and benefit/cost analysis (i.e., return on investment). For instance, conventional performance measures may include travel time (congestion), equity, environmental impacts, safety, preservation, transit ridership, and access to jobs. Prioritization of economic factors may include economic development potential; market access and attraction; whether a project is located within an economic development policy area (e.g., a state-endorsed, tax-free zone or enterprise zone with tax incentives); or its contribution to GRP. Results from the performance assessment of projects, after the inclusion of economic factors, may force policy-makers to reexamine their priorities and accept some difficult tradeoffs between economic growth, livability, and equity.

Several states or regions do include economic development criteria in their project prioritization process. Economic development criteria can include the following:

- Expected job creation or retention, a measure of the severity of economic distress;
- The cost effectiveness of investment; and
- The level of private sector capital attracted to the state/region by projects.

Rankings can be determined by an expert panel, quantitative rankings, or through committees convened by either the state and/or region

Kansas DOT used a set of economic development criteria to rank and prioritize its local economic development enhancement programs. For expansion projects, 25 percent of the projects were scored using economic development criteria, including the following three factors:

1. **Anticipated change in study area jobs by 2030.** This factor included jobs created by contingent development due to the project, jobs created or retained as a result of improved economic productivity due to shorter and more predictable travel times, and jobs created or retained as a result of expansion in markets due to improved travel speeds or improved access.
2. **Anticipated change in net present value of study area GRP/safety benefits by 2030.** This factor included GRP added due to contingent development as a result of the project, GRP added due to improved economic productivity caused by shorter and more predictable travel times, GRP added due to expansion in markets caused by improved travel speeds or improved access, and safety benefits caused by a reduction in injuries and fatalities on safer roads.
3. **Business attraction.** An expert panel made up of 16 members from cities, chambers of commerce, business associations, universities, and regional agencies assigned points for potential business attraction based on knowledge of the project and the types of businesses projected to locate near the new expansion project. Final points were assigned by the panel as opposed to conducting a quantitative modeling exercise.

Georgia DOT began looking into economic performance measures when multiple sources were competing for limited fiscal resources. Economics-focused performance measures provided additional information to support decision-making under these constrained conditions. Starting in the Statewide Transportation Plan (STWP) in 2005, Georgia DOT highlighted Economic Growth as one of the five goals in the plan (in addition to Preservation, Safety, Congestion, and Connectivity/Access/Mobility). Georgia also has a Statewide Transportation Improvement Program (STIP) that takes the overall vision from the long-range planning and programs projects. Georgia DOT pioneered a process to select projects included in the Fiscal Year (FY) 2010 to 2013 STIP, which is called the Project Prioritization Process. It is a systematic approach for choosing projects that enables leadership to prioritize based on project benefits/cost and risk.

As part of the FY 2010 to 2013 STIP, more than 900 projects were evaluated with two performance metrics related to economic growth, as described below:

4. **Change in Gross State Product**, which is calculated for each project in year 2035 based on vehicle hours traveled (VHT) savings; and
5. **Economic Development Policy Area**, which is determined based on whether a project was located within an economic development policy area (located in a county with an "eligible" classification and/or a Job Tax Credit Program classification of "Tier 1").

Wisconsin DOT also uses economic performance in long-range planning. Projects are prioritized by their potential to increase the productivity of the specific industries along the corridors served by the projects. A highway project with great potential for contributing to the productivity of the industries along the corridor will score higher than a project with less potential to boost the productivity of industries along its route. Through this type of analysis, the highway network in Wisconsin is designed to increase the efficiency and competitiveness of businesses in the state, allowing firms to increase output and hire new workers. Once projects are selected and included in a plan, the next step is finding funding to implement them. The state administers a program called the Transportation Economic Assistance (TEA), which provides grants to public and private businesses to both attract new employers to Wisconsin, and retain and expand existing businesses. Although applications for the TEA program are on a first-come, first-served basis, they must undergo eligibility requirements, including the completion of an economic impact analysis. Projects selected from the plan are highly encouraged to apply for these funds.

B.5 BEST PRACTICE INTERVIEWS

Table B.2 lists the regions and individuals interviewed for this effort. The remainder of the appendix describes each best practice in greater detail.

Table B.2 Best Practices Interviewees

	Type	Agency	Name	Role/Department
1	MPO	PSRC	Bob Drewel	Executive Director
			Jason Thibedeau	Associate Economic Policy Analyst, Prosperity Partnership
2	RPA	New York RPA	Bob Yaro	President
3	EDC	LA EDC	Joanne Golden	Director of Public Policy
4	EDC	San Diego EDC	Lauree Sahba	Chief Operating Officer
5	DOT	Georgia DOT	Tim Kassa	Planning Branch Chief, Statewide Research & Development Branch
6	DOT	Kansas DOT	Deb Miller David Schwartz	Bureau of Transportation Planning
7	DOT	Wisconsin DOT	Dennis Leong	Division of Transportation Investment Management
			Bob Russell	Transportation Economist

B.6 PUGET SOUND REGIONAL COUNCIL (PSRC)

PSRC is the regional transportation, economic development, and growth management planning organization for the four-county Seattle metropolitan area

surrounding Puget Sound. PSRC conducts long-range planning (20 to 30 years in the future) for growth management, transportation, and economic development. It also collects regional data on demographics, housing, unemployment, building permits, and traffic counts; and analyzes to inform public policy.

Following a merger in 2002 between PSRC and the Central Puget Sound Economic Development District, PSRC's Executive Board expressed interest in having PSRC take a more active role in economic strategy development. The Board stressed the importance of working in concert with the region's private sector leaders and the four counties' economic development councils.

Starting in the spring of 2004, PSRC staff crafted a work plan to develop a long-range regional economic strategy. Given the importance of integrating economic planning with land use and transportation planning, the Economic Development District Board agreed that the strategy should be developed to serve as the functional economic plan of the broader long-range plan, which PSRC calls VISION.

The development of the strategy was launched in the summer of 2004. The year after it was launched, PSRC worked with hundreds of business, labor, government, nonprofit, and community leaders in King, Kitsap, Pierce, and Snohomish Counties; and has since organized a coalition called the Prosperity Partnership. With the goal of developing a Regional Economic Strategy, the Prosperity Partnership has engaged in a year of analysis, outreach, and discussion.

Since then, PSRC has been working with local governments, business, and citizens to build a common vision for future transportation, land use, and economic development, expressed through three connected major activities: VISION 2040, the region's growth strategy and multicounty planning policies; Transportation 2040, the region's long-range transportation plan; and Prosperity Partnership, which develops and advances the region's economic strategy. This integrated approach to planning strengthens the economic link between transportation and land use plans.

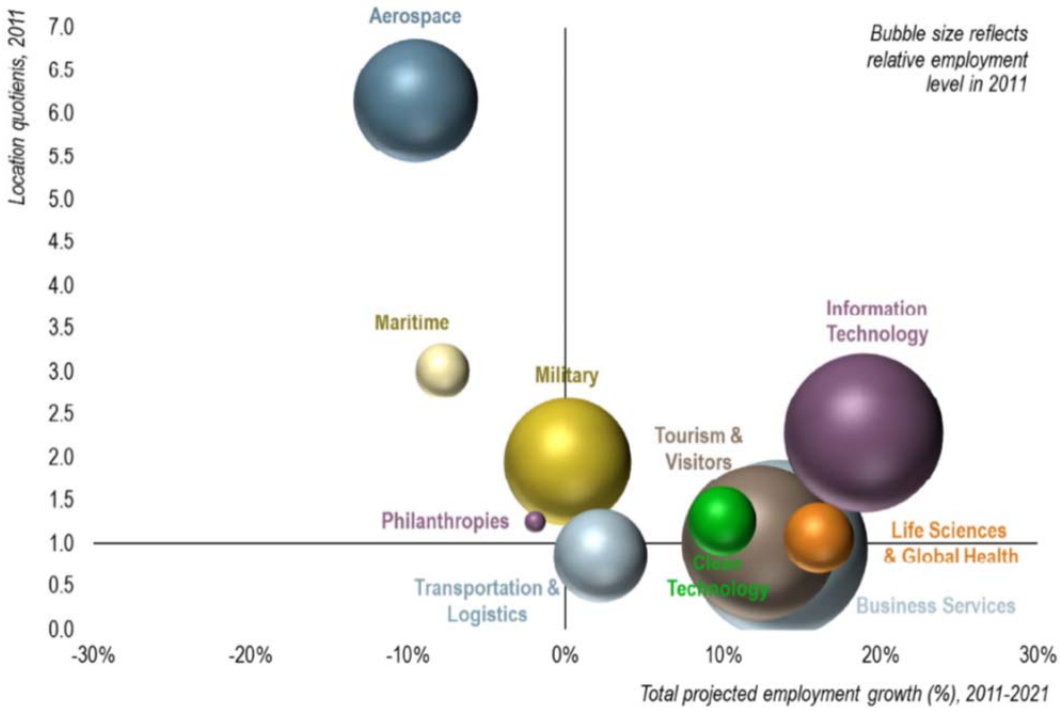
A key objective of the work was to identify discrete, actionable initiatives that were implementable. For instance, under the goal to advance the region's infrastructure to meet the demands of a globally connected modern economy, the following strategies and action items are presented.

- **Strategy:** Maintain and improve the region's physical infrastructure to support the needs of established and emerging industry clusters.
- **Actions:**
  - Encourage and support the implementation of Transportation 2040; and
  - Educate leaders on the importance of a national freight strategy that meets the strategic interests of the Puget Sound region.

- **Strategy:** Improve methods for including economic development criteria into regional infrastructure evaluation programs.
- **Action:**
  - Continue to work with regional stakeholders to refine and prioritize scoring measures as part of Transportation 2040; and
  - Research criteria and tools for evaluating and describing economic development projects under consideration for public support.
- **Strategy:** Improve the jobs-housing balance in the region to minimize transportation system impacts of projected growth.
- **Action:**
  - Support the work of the Growing Transit Communities Partnership to develop best practices that align regional transportation and land use investments, and ensure governments throughout the region have access to this information.
- **Strategy:** Preserve and protect industrial and military lands from encroachment and incompatible uses in order to support the economy's industrial base.
- **Action:**
  - Update PSRC's Industrial Lands inventory; and
  - Develop a regionwide strategy for industrial lands.

PSRC has focused on having a data-driven Regional Economic Strategy with recommendations and strategies that would be supported by current and updatable information. Figure B.1 is an example of the type of data-driven analysis PSRC has conducted to understand regional cluster dynamics. The horizontal axis shows total projected employment percentage growth, and the vertical axis shows employment location quotients. The size of the bubble reflects 2011 employment levels. In term of employment growth, information technology, business services, life sciences, global health, tourism and visitors, and clean technology are the fastest growing sectors in the region.

Figure B.1 Central Puget Sound Cluster Employment Dynamics
Relative Employment Concentration (2011) and Growth Trends (2011 to 2021)



Source: Regional Economic Strategy for the Central Puget Sound Region: Strategy, 2012.

As for performance measurement, the development of specific metrics for measuring the performance of the Regional Economic Strategy will be a subsequent effort of the Prosperity Partnership after implementation of the strategy has begun. Performance measuring will be appropriately coordinated with PSRC's Monitoring Program. The performance measures will be developed jointly for the 2040 updates for the VISION, Transportation, and Regional Economic Development plan. All three will be developed and adopted in the same year, which provides a strong motivation for integration.

For the update of Transportation 2040 adopted in June 2012, the Board agreed on nine measures, of which one is a measure of "access to areas of high job concentration" ("jobs measure"), as shown in Figure B.2. This measure will be included in the project prioritization process that leads to the financially constrained RTP. The jobs measure is meant to address the extent to which projects support existing and new businesses and job creation.

Figure B.2 PSRC Project Prioritization for Transportation 2040 Update: Jobs Measure

	Purpose: Access to areas of high job concentration. How well does the project support job retention or expansion by improving access?		
Points	Choose one	3	The area served by this project has an employment density[6] of 18 jobs per acre, and is planned (has unused zoned capacity) to accommodate a density of 32 jobs per acre. (Areas that currently exceed the higher threshold would receive points here as well).
		1	The area served by this project has an employment density of 18 jobs per acre.
	2		The area served by this project has an employment density of 15 jobs per acre for jobs related to cluster employment.[7]
	2		The area served by this project has an employment density of 15 jobs per acre for family-wage related employment.
	Purpose: Access to economic foundations. How well does the project provide access to job-related training or educational opportunities (vocational schools, community colleges, universities)?		
	3		In area with, or supports access to institutions identified as economic foundations.
Total	10 (max)		

Source: Puget Sound Regional Council. http://psrc.org/assets/8478/Prioritization-measures.pdf.

B.7 NEW YORK REGIONAL PLAN ASSOCIATION (RPA)

RPA is an independent regional planning organization, as well as an urban research and advocacy group. RPA prepares long-range plans and policies to advocate for smart growth and efficient development of the New York-New Jersey-Connecticut metropolitan region. RPA provides regional leadership on national infrastructure, sustainability, and competitiveness concerns. It convenes and provides a forum for the region's business, philanthropic, civic, and planning communities. It also has provided technical assistance and strategic advising for the New York Metropolitan Transportation Council, the New York region's MPO.

The beginnings of economy as a third "E" (with equity and environment) for the RPA came about during the RPA's third regional plan, A Region at Risk, published in 1996. This advocacy plan recommended an implementation strategy organized around five "action campaigns" (greensward – a vision of a system of protected landscape and water bodies that distinguish the cities and suburbs of the New York-New Jersey-Connecticut metropolitan region, centers, mobility, workforce, governance) that focused effort on building civic coalitions in the region. Several of these action campaigns – specifically "centers" and "mobility" – supported transportation and land use integration even before "smart growth" was a phrase in common planning parlance.

During the A Region at Risk planning process, the RPA formed a set of board members concerned with regional economy competitiveness, and established a set of indicators to quantitatively measure and track performance of the economy, using metrics of per capita income, number of jobs in region, percentage of population employed, real average wage, and GRP growth.

Because the RPA is independent and not-for-profit, it does not hold purse strings for large infrastructure investments or projects in a regional plan; however, it has been very influential in decisions that link transportation, land use, and economic competitiveness. In the last year, the RPA's national infrastructure planning and policy program, America 2050, teamed with the Business Alliance for Northeast Mobility to build a case for investment in the national rail system, as well as the Northeast corridor. RPA has become a national leader in the debate on high-speed rail, and where and how Federal and private funds should best be employed.

RPA has participated in campaigns that led to the creation of the New York MTA, which transformed New York metropolitan area into a polycentric region with urban centers around an expanded rail system. For example, Stamford, Connecticut, has become a jobs center along with being a residential area, with commuting both in and out of the City.

In 2010, organizations in the New York metropolitan area, including Connecticut, joined forces to form a New York-Connecticut Sustainable Communities Consortium, which aimed to develop growth centers around planned transit hubs, and to continue to expand economic opportunities in the region.

RPA, in the words of its director, realizes the importance of building a "coalition of the willing." Some suburban towns with large regional rail stations have refused to allow the creation of additional multifamily dwelling units. However, RPA, as an advocate, has focused on supporting development in cities and towns that are interested in growing and willing to make land use changes with more tightly linked transportation and land use investments.

Finally, RPA has also formed the Empire State Transportation Alliance (ESTA), an independent group of the Region's civic, business, transportation, and environmental leaders. The Alliance was launched in 1999 and has continued to lead education and outreach campaigns that have resulted in billions of dollars in transit investments in the region. To support many of these campaigns, they author reports to measure the economic benefits of investments. Approximately 35 different groups participate, raising funds from foundations to staff the Alliance and develop priorities.

B.8 LOS ANGELES ECONOMIC DEVELOPMENT CORPORATION (LA EDC)

The LA EDC was founded in 1981 to attract, retain, and grow businesses and jobs for LA County. It provides free business assistance and attraction programs, economic research, fee-supported economic and policy analysis, and public policy guidance. It also works closely with regional planning agencies, such as the Los Angeles County Metropolitan Transportation Authority, as well as SCAG.

In early 2009, LA EDC began the process for a strategic plan that engaged and solicited input from more than 1,000 stakeholders and two dozen public forums to develop a consensus-built Strategic Plan for Economic Development in the County. Currently in its third year of implementation, the plan was adopted by 84 out of 88 cities, as well as the LA County Board of Supervisors.

Five core goals were outlined in this plan: educated workforce, business-friendly environment, attractive quality of life, smart land use, and 21st century infrastructure. Smart land use and 21st century infrastructure are both tied to linking transportation, land use, and economic growth. The key focus of the smart land use goal is the preservation of land for commercial and industrial uses. Because of high population density, horizontal sprawl and loss of land zoned for industrial use in the County, the strategies focus on infill development, redevelopment, and the reuse of obsolete industrial land. The 21st century infrastructure goal includes promoting enabling legislation for best practices in design/build, public-private partnerships, and performance contracting to expedite infrastructure development, advocating for a fair share of public infrastructure dollars to support local communities, expedite green growth at the ports, and modernize the Los Angeles International Airport, among others. Additionally, it also strives to improve the quality and user appeal for mass transit and alternative modes, while investing in goods movement infrastructure.

Because the LA EDC has no implementation authority, it works with "implementation champions," who lead the charge for each goal area and produce yearly progress reports. Urban Land Institute (ULI) is the implementation champion for smart land use Moving forward one of the objectives, the LA EDC and ULI worked with the LA County General Plan through guidelines (not parcel by parcel) to develop "employment protection land districts" that highlighted the areas for preserving an industrial land base. These areas represent economically viable industrial and employment-rich lands, where industrial zoning and land use designations should remain, and where policies to protect industrial land from other uses (residential and commercial) should be enforced. The analysis inventoried and analyzed existing industrial land uses, zoning, and policies to inform site-specific policy recommendations.

LA EDC is itself the champion of the 21st Century Infrastructure goal, which focuses on fixing the "broken" infrastructure development process, and building

and maintaining critical infrastructure in LA County. This means supporting public-private partnerships and refocusing CEQA on improving environmental outcomes, while eliminating its nonenvironmental uses, as well as ensuring the agency continues to address the infrastructure maintenance deficit in LA County.

In addition, LA EDC participates in the SCAG's Southern California Economic Recovery and Job Creation Strategy, which feeds into to the region's RTP/SCS process. In 2010, SCAG hosted the Southern California's Road to Economic Recovery summit for SCAG's Regional Council (also known as the Global Land Use Economic Council) to discuss initial key findings of their analysis to retain and create employment in the LA region. The Summit also provided a forum for business leaders to discuss and understand high-priority state impediments to economic recovery, as well as reach consensus on next steps for removing them. More than 300 leaders participated, including key business leaders, cities, and counties.[41]

B.9 SAN DIEGO REGIONAL ECONOMIC DEVELOPMENT CORPORATION (EDC)

San Diego Regional EDC is an organization privately funded by business membership and charged with attracting and retaining business to the San Diego area. It is supported by more than 135 companies that are committed to ensuring the prosperity of the San Diego region, and helping to attract high-wage companies to the region – specifically in the sectors related to technology, military, and tourism. It also assists local firms with expansion plans, and champions efforts to improve the region's competitiveness.

San Diego Regional EDC has implemented several initiatives to link transportation, land use, and economic development. First, it introduced a set of indicators that measure sustainable competitiveness (described below) that led to the development of TransNet, the reauthorization of a one-half-cent sales tax for local transportation projects that was first approved by voters in 1988, and then extended in 2004 for another 40 years. The San Diego economic development planners and regional planners used the sales tax to rally continued support for transportation investments that lead to economic growth and competiveness, and support a high quality of life to retain a skilled labor force in the region.

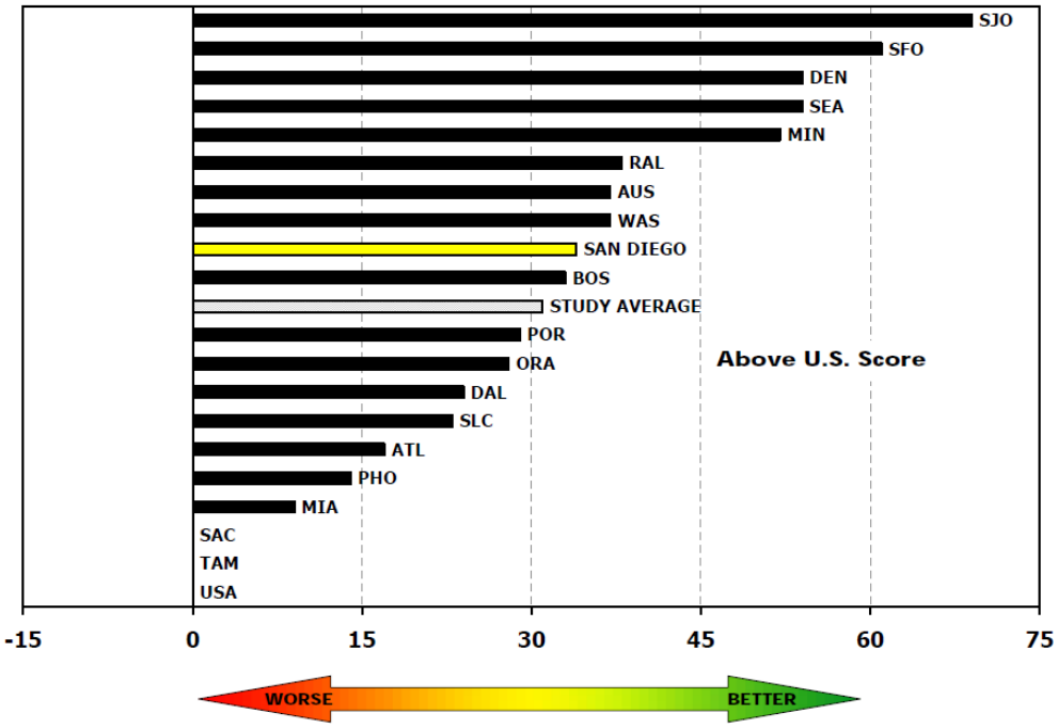
In the early stages of this effort, EDC launched the Partnership for the New Economy, which sought to understand the competitiveness of San Diego in terms of four technology industries. That initiative – which won top awards from the U.S. Department of Commerce – led to significant outcomes for the region's long-term prosperity. Engagement with more than 200 top-rated technology

[41] Southern California Economic Recovery and Jobs Creation Strategy, 2011, http://www.scag.ca.gov/ga2011/pdf/FINAL_SCERS_GA.pdf.

companies was key. These companies were asked what it would take for them to grow in the region. EDC had assumed the top barriers to growth would include high housing prices and the inability to retain talent in the face of competition with other regions. However, transportation and traffic were the top concerns raised by these firms. These results were critical to the campaign to extend TransNet, which has secured funding over the next 40 years for expanding the region's transportation system, reducing traffic congestion, and bringing essential transportation programs to life. The EDC worked with Metropolitan Transit System and environmental groups to allocate one-third of the sales tax to creating and preserving open space, one-third to transit, and one-third to highways. More than $17 billion has been generated and distributed to highway, transit, and local road projects to-date.

The second EDC initiative to link transportation, land use, and economic development involved a partnership between the City of San Diego and SANDAG. In 2001, EDC launched a study, known as the Indicators of Sustainable Competitiveness, to measure San Diego's economic standing against similar regional markets and the United States average. A blue-ribbon advisory committee of civic and business association leaders, local elected officials, education and workforce training providers, and public facility operators provided oversight to the project. One of the study's key conclusions identified the need for an evaluation of San Diego's sustainability index over time compared to rival regions. Such results offer longitudinal comparisons that support long-range planning. Figure B.3 illustrates San Diego's 2005 standing. An update to the study currently is underway.

Figure B.3 How San Diego Compares to Other Regions in Term of Sustainability Index[a]



[a] The Sustainability Index is a conglomeration of multiple indicators, including economy, environment, and equity components. With regards to economy, San Diego is ranked against 18 other regions comparing real per capita income, state business climate, venture capital, initial public offerings, patents, educational attainment/talent, and capital outlays.

Source: San Diego Regional EDC and SANDAG, Indicators of Sustainable Competiveness: Quality of Life Index for San Diego, 2005.

B.10 Georgia Department Of Transportation (DOT)

The Georgia DOT plans, constructs, maintains, and improves the State's road and bridges; provides planning and financial support for other modes of transportation, such as mass transit and airports; provides airport and air safety planning; and provides air travel to state department employees during special circumstances. The DOT also provides administrative support to the State Road and Tollway Authority and the Georgia Rail Passenger Authority. A majority of the DOT's resources are directed toward maintaining and improving the State's network of roads and bridges. Proceeds from the State's motor fuel taxes are constitutionally earmarked solely for use on Georgia's roads and bridges. Nonroad and bridge construction projects are supported by a combination of state general funds, Federal funds, and local funds.

Every five years, Georgia DOT undertakes a long-range planning process. In 2005, it developed a Statewide Transportation Plan (SWTP) that covered the years 2005 to 2035. Then, in 2010, it developed the Statewide Strategic Transportation Plan (SSTP) that covered the years 2010 to 2030. Although the horizon year for the SSTP was shorter than for the SWTP, the intent in 2010 was to evaluate the return on investment from funding different types of transportation modes and projects.

Starting in the SWTP, Georgia DOT already highlighted Economic Growth as one of the five goals in the plan (in addition to Preservation, Safety, Congestion, and Connectivity/Access/Mobility). Georgia also has an STIP that takes the overall vision from the long-range planning and programs projects. Georgia DOT pioneered a process to select projects included in the FY 2010 to 2013 STIP, which is called the Project Prioritization Process. It is a systematic approach for choosing projects that enables leadership to prioritize based on project benefits/ cost and risk.

In the FY 2010 to 2013 STIP, there were more than 900 projects falling into the following three categories:

1. **Highway New Capacity Projects.** These projects include widening existing roadways and constructing entirely new roadways. They form a core part of Georgia DOT's work program. The primary objective of these projects is typically congestion reduction and improved connectivity.
2. **Economic Development Projects.** This category includes projects in the Governor's Road Improvement Program (GRIP), which is intended to provide four-lane highway access to the interstate system to communities across the State outside of the major metropolitan areas.
3. **Traffic Operations Projects.** These projects include Automated Traffic Management and Information Systems (ATMS/ATIS) projects and continuous center turn lanes.

Using the Project Prioritization Process, 10 measures were used for project evaluation and prioritization, including two related to economic growth, listed as follows:

1. **Change in Gross State Product (GSP)**, which is calculated for each project in year 2035 based on VHT savings, using an equation developed with Georgia Highway Economic Analysis Tool (HEAT).
2. **Economic Development Policy Area**, which is determined based on the answer to the following question, "Is the project located within an economic development policy area?" The answer to this question is yes, if the project is in a county that has a classification of "eligible" and/or a Job Tax Credit Program classification of "Tier 1."

Figure B.4 summarizes the two economic development measures used to support the SWTP and the way it was operationalized using the Project Prioritization Process in the FY 2010 to 2013 STIP.

Figure B.4 Project Prioritization Process Used in the STIP and Mapped to the SWTP Goals

	SWTP Goals							
Program	**Preservation**	**Safety**	**Congestion (70%)***	**Connectivity Access and Mobility**	**Economic Growth**	**Total Score**	**Benefit / Cost**	**Other Factors**
Roadway Capital Maintenance								
Roadway New Capacity	1. Structural Deficiency 2. PACES Rating	3. Crash Reduction (by severity)	4. Delay Reduction	5. Travel Time: Truck Route/ IM Conn./STRAHNET 6. Activity Center 7. Land Use Plan 8. Access Mgmt.	9. Gross State Product 10. Economic Development Policy Area		B/C	Deliverability, Funding Sources, Readiness, etc.
Roadway Traffic Operations		1. Crash Reduction (by severity)	2. Delay Reduction	3. Travel Time: Truck Route/ IM Conn./STRAHNET 4. Activity Center	5. Gross State Product 6. Economic Development Policy Area		B/C	Deliverability, Funding Sources, Readiness, etc.
Roadway Safety								
Transit								
Intermodal								
Demand Mgmt.								
Economic Development	1. Structural Deficiency 2. PACES Rating	3. Crash Reduction (by severity)	4. Delay Reduction	5. Travel Time: Truck Route/ IM Conn./STRAHNET 6. Activity Center 7. Land Use Plan 8. Access Mgmt.	9. Gross State Product 10. Economic Development Policy Area		B/C	Deliverability, Funding Sources, Readiness, etc.
Enhancement								

Source: Cambridge Systematics, Inc., 2008.

Georgia DOT developed an automated Excel spreadsheet tool to easily generate scores and performance measures for the 900 projects, making the technical procedure simplified. The overall project performance was bucketed into four tiers (1 through 4) and recommended for funding based on these tiers. To generate results, Georgia DOT employed a small dedicated staff – four people from start to finish. Because data was already in the system, the data collection was easy, although quality assurance (QA)/quality control (QC) was more effort than expected.

The biggest challenge for Georgia DOT was arriving at consensus with the planning partners. There was initial disagreement on the Project Prioritization Process approach and methodology from various departments and staff. Staff had to communicate the methodology transparently and methodically in front of stakeholders in showing how scores were assigned. Georgia DOT ensured MPOs, regional commissions, as well as the two transit authorities, were at the table during this process. For any future performance-based planning efforts with economic impacts elements, Georgia DOT will plan to have a project manager completely dedicated to this exercise.

In 2007, during the lead-up to the development of the 2010-2030 SSTP, the recession and overall financial climate prompted the Georgia DOT again to incorporate economic measures and analysis into their planning, programming, and overall work program. Multiple priorities competed for limited fiscal resources. Economics-focused performance measures were thought to provide additional information that would support decision-making, but would not limit

or restrain the agency in any way. Thus, during the development of the SSTP, the first of the four adopted goals was to support Georgia's economic and competitiveness. Figure B.5 shows the goals, objectives, and performance measures stemming from the SSTP.

Figure B.5 Goals, Objectives, and Performance Measures in the Georgia DOT SSTP

Goal	Objective	Performance Metric
1 Supporting Georgia's economic growth and competitiveness	Improved access to jobs, encouraging growth in private-sector employment, work force	▪ Average number of workers reaching major employment centers by car in 45 minutes* ▪ Average number of workers reaching major employment centers by transit in 45 minutes*
	Reduction in traffic congestion costs	▪ Annual congestion cost*
	Improved efficiency, reliability of commutes in major metropolitan areas	▪ Average commute time* ▪ Number of people taking reliable trips per day (peak hour)*
	Efficiency and reliability of freight, cargo, and goods movement	▪ Travel times between Georgia "gateways" and key origins and destinations ▪ Supply-chain costs by corridor (cost of congestion + direct inventory cost + obsolescence cost)
	Border to border and interregional connectivity	▪ Interstate share of vehicle miles traveled (VMT) ▪ % of population within 20 miles of a 4-lane highway
	Support for local connectivity to statewide transportation network	▪ % of state transportation funding spent on local roads
2 Ensuring safety and security	Reduction in crashes resulting in injury and loss of life	▪ Number of traffic fatalities
3 Maximizing the value of Georgia's assets, getting the most out of the existing network	Optimized capital asset management	▪ % of state highways with pavements that meet or exceed minimum standards ▪ % of state bridges that meet or exceed minimum standards ▪ % of transit assets in "Good Repair"
	Optimized throughput of people and goods through network assets throughout the day	▪ Peak-hour freeway VMT* ▪ Peak-hour freeway speed: managed lanes, HOV vs. general purpose* ▪ Freeway accident clearance time* ▪ Peak-hour mode split (total/markets served by transit) ▪ Operating cost per unlinked passenger trip by mode ▪ Operating cost per passenger mile by mode
4 Minimize impact on the environment	Reduce emissions, improve air quality statewide, limit footprint	▪ Exceedances of federal 8-hour ozone standard

*This metric is obtained for Metropolitan Atlanta only.

Source: Georgia DOT Statewide Strategic Transportation Plan (2010 to 2030), April 2010.

It remains to be seen how these performance measures will be applied to future STIPs.

B.11 KANSAS DEPARTMENT OF TRANSPORTATION (DOT)

The Kansas DOT is a state government organization in charge of maintaining public roadways in the State of Kansas. It is the department responsible for road and bridge maintenance, transportation planning, contract compliance, and transportation-related administrative support.

In August 2008, the governor created the Transportation-Leveraging Investments in Kansas (T-Link) Task Force to examine the state of transportation in Kansas, and to develop a set of recommendations that "frame a new strategic approach to

its future transportation needs." The T-Link Task Force developed the project selection process.

The T-Link Blue Ribbon Panel (local officials, construction industry, etc.) was instated to add economic analysis in project selection. In that process, Kansas DOT worked closely with chambers of commerce, cities, and counties (staff and elected officials); five MPOs (staff and board); transit; aviation; rail; contractors; and motor carriers; and three to four times. The e-mail list for this process included more than 2,000 names.

Over the last 10 years, Kansas DOT has become increasingly more sophisticated in its ability to communicate about economic impacts. Over this period of time, the agency has done three studies in this arena.

1. Kansas DOT started looking at projects that had already been built to measure the economic impact pre- and post-development. Kansas DOT assembled a report on five case studies using an approach laid out by the Federal Highway Administration (FHWA). They conducted a shift-share analysis, a standard regional analysis method that attempts to determine how much of regional job growth can be attributed to national trends, and how much is due to unique regional factors. In this way, they could take a transportation project in one county and compare it to a peer county that did not invest in the transportation project to look at whether the major transportation investment was a contributor to economic growth.
2. Kansas DOT did a study on maintaining current investment in existing infrastructure from the standpoint of transportation's economic importance. To show the importance of SGR, this study evaluated what would happen if maintenance funding declined dramatically and looked at different scenarios for the State.
3. In the last few years, Kansas DOT has been establishing a new program for thinking about a series of expansion-type projects. These would be tied to economic growth in certain parts of the State, and help legislators build a story about economic impacts in transportation investments for the long-range transportation plan. Kansas DOT created a working group to move beyond talking about travel time savings and other "esoteric" measures, but more on how to communicate how a project creates jobs or economic growth.

Performance Measures

Three metrics were used to "score" projects: engineering data based on its performance relative to other projects in terms of various engineering factors, such as a project's impact on congestion and safety; a local consult score based on: 1) discussions from an expert panel, 2) perceived safety, and 3) system connectivity benefits; and an economic impact score based on its performance in terms of creating or retaining jobs (excluding construction jobs), expanding GRP, and increasing the value of traveler benefits in terms of their time costs, vehicle costs, and safety costs. These allocations of project scores are shown in

Figure B.6 for each category of project by criteria and weighted accordingly. To reflect differences in decision-making among project categories, the T-Link Task Force recommended a weighting system shown in Figure B.6.

Figure B.6 Scoring Criteria by Project Type for Kansas DOT T-Links Projects

	Engineering Data	Local Consult	Economic Impact
Preservation	100%		
Modernization	80%	20%	
Expansion	50%	25%	25%

Source: Kansas DOT Briefing Paper: Expanded Highway Project Selection Process, 2010.

Preservation projects were selected on the basis of engineering criteria alone. They tended to generate little public discussion, and their solution was grounded in engineering design. Modernization projects also were primarily engineering driven, but the priority formula could not capture specific local conditions, such as whether a school is located on a stretch of road; therefore, a local consult component was part of the project score for modernization projects. Expansion projects had to consider both engineering criteria and the economic well being of the State. These large-scale, costly projects required more public discussion because they engendered a wider range of public opinion, and they require evaluation of economic impacts.

For expansion projects, Kansas DOT calculated an economic impact score based on its performance in terms of creating or retaining jobs (excluding construction jobs); expanding GRP; and increasing the value of traveler benefits in terms of their time costs, vehicle costs, and safety costs.

All Kansas DOT's economic impact scores are derived from a macroeconomic input-output (I/O) model of the Kansas economy. Two main metrics that comprised the economic impact score were then evaluated based on the outputs generated from TREDIS:

1. **Anticipated change in study area jobs by 2030.** This may include jobs created by contingent development as a result of the project, jobs created or retained as a result of improved economic productivity due to shorter and more predictable travel times, and jobs created or retained as a result of expansion in markets due to improved travel speeds or improved access.
2. **Anticipated change in net present value of study area GRP/safety benefits by 2030.** This may include GRP added due to contingent development as a result of the project, GRP added due to improved economic productivity caused by shorter and more predictable travel times, GRP added due to

expansion in markets caused by improved travel speeds or improved access, and safety benefits caused by a reduction in injuries and fatalities on safer roads.

One challenge in the analysis was anticipating an agreed-upon change in study area jobs from business attraction. The change in jobs presumed a notion of growth impacts with adjacent uses that were newly attracted due to project implementation. The assumptions on whether a project could attract many new businesses, or just a handful could diverge widely depending on the model used. It often took multiple meetings with the project sponsors, including stakeholders from businesses, city and county representatives, and local economic development staff to agree on these assumptions, and a final number of jobs created from a new transportation project.

Kansas DOT conducted much of the analysis associated with the project selection criteria internally; however, they outsourced the economic impact scores to an outside consultant. Once the outside consultant generated the analysis scores for the limited set of expansion projects, the overall learning curve for assembling the project score was short, as staff did not need that much training. Although it took several staff people over multiple months, the final assembly of project scoring did not require an outside consultant or extra resources outside the agency. However, there was a lot of internal support at the executive level to make the case that this was an important issue.

Kansas DOT was committed to a credible straightforward process. The goal was not to create a black box that nobody understood. Ultimately, it was important to recognize that economic impact is an important factor in project selection, but should not be the only factor. If economic impact was the only performance measure used, it would have undesirable result for transportation provision.

B.12 Wisconsin Department Of Transportation (DOT)

The Wisconsin DOT was officially established in 1967 by combining formerly independent agencies and the Department of Motor Vehicles (which included the State Highway Commission, State Aeronautics Commission and State Patrol). Wisconsin DOT is responsible for planning, building, and maintaining Wisconsin's network of state highways and interstate highway system. The department shares the costs of building and operating county and local transportation systems – from highways to public transit and other modes. The DOT also plans, promotes, and financially supports statewide air, rail, and water transportation, as well as bicycle and pedestrian facilities.

Wisconsin's Transportation Development Association produced a study of the benefits of transportation investment in Wisconsin. The study included both quantitative and qualitative research on how transportation investment affects business efficiency, job creation, economic business growth, tax revenues, safety,

and quality of life. This helps to make the case for transportation investments in Wisconsin.

Beginning in 1981, the Wisconsin Legislature renewed a transportation bonding program that led to the formation of the Transportation Projects Commission (TPC). The TPC was tasked with evaluating the merits of proposed major projects, and recommending projects to the Governor and Legislature for statutory enumeration (i.e., authorization for construction). Wisconsin DOT is responsible for analyzing the potential economic development benefits for these major projects. The selection of major highway investment projects in Wisconsin is explicitly based upon the potential each project has to contribute to economic development, both regionally and statewide. Highway infrastructure investments most strongly support economic growth through their impact on industrial productivity; good investments make regional industries more efficient by lowering their overall transportation costs.

Wisconsin also has a program, started in 1987, called the TEA, which provides state grants to public and private businesses to help attract employers to Wisconsin, and to help businesses remain and expand in the State, creating jobs and economic development. Because of these two programs, Wisconsin had an early start to the development of economic impact analyses. For more than 25 years, Wisconsin has conducted many analyses at the policy, program, and project levels, as well as a variety of modal economic studies.

Performance Measures

For evaluating and ranking major highway projects from an economic development perspective, performance measures include the following.[42]

- Business impacts to manufacturing, services, and retail businesses (data collected by phone interviews).
- Community economic impacts (data collected by regional and state economic data):
  - Change in population;
  - Change in tourism expenditures;
  - Change in number of businesses (i.e., growth) from 1995 to 2003;
  - Total new and expanded manufacturers within five miles of Highways 29 and 10;
  - Change in per capita income in counties along four-lane expressways;

[42] Economic and Land Use Impacts of Wisconsin State Trunk Highway 29. Wisconsin DOT, July 2004, http://wisdotresearch.wi.gov/wp-content/uploads/03-06highway291.pdf.

- Change in annual average daily traffic counts;
- Change in county commuting patterns; and
- Change in property values.

Based on economic modeling and analysis conducted in-house, projects' impacts to the economy are compared against a no-build scenario. Projects are then prioritized by their potential to increase the productivity of the specific industries along the corridors served by the projects. A highway project with great potential for contributing to the productivity of the industries along the corridor will score higher than a project with less potential to boost the productivity of industries along its route. Through this type of analysis, the highway network in Wisconsin is designed to increase the efficiency and competitiveness of businesses in the State, allowing firms to increase output and hire new workers.

Wisconsin DOT is fortunate to have many resources for economic impact analysis. Because the efforts started in the late 1980s, there have been many years of capacity building, staff training, and a continuous move to improve the technical capacity within the agency. Over the years, strong collaborations have been formed with the Wisconsin Department of Commerce, the Department of Natural Resources, and the Department of Agriculture, as well as the various trade associations.

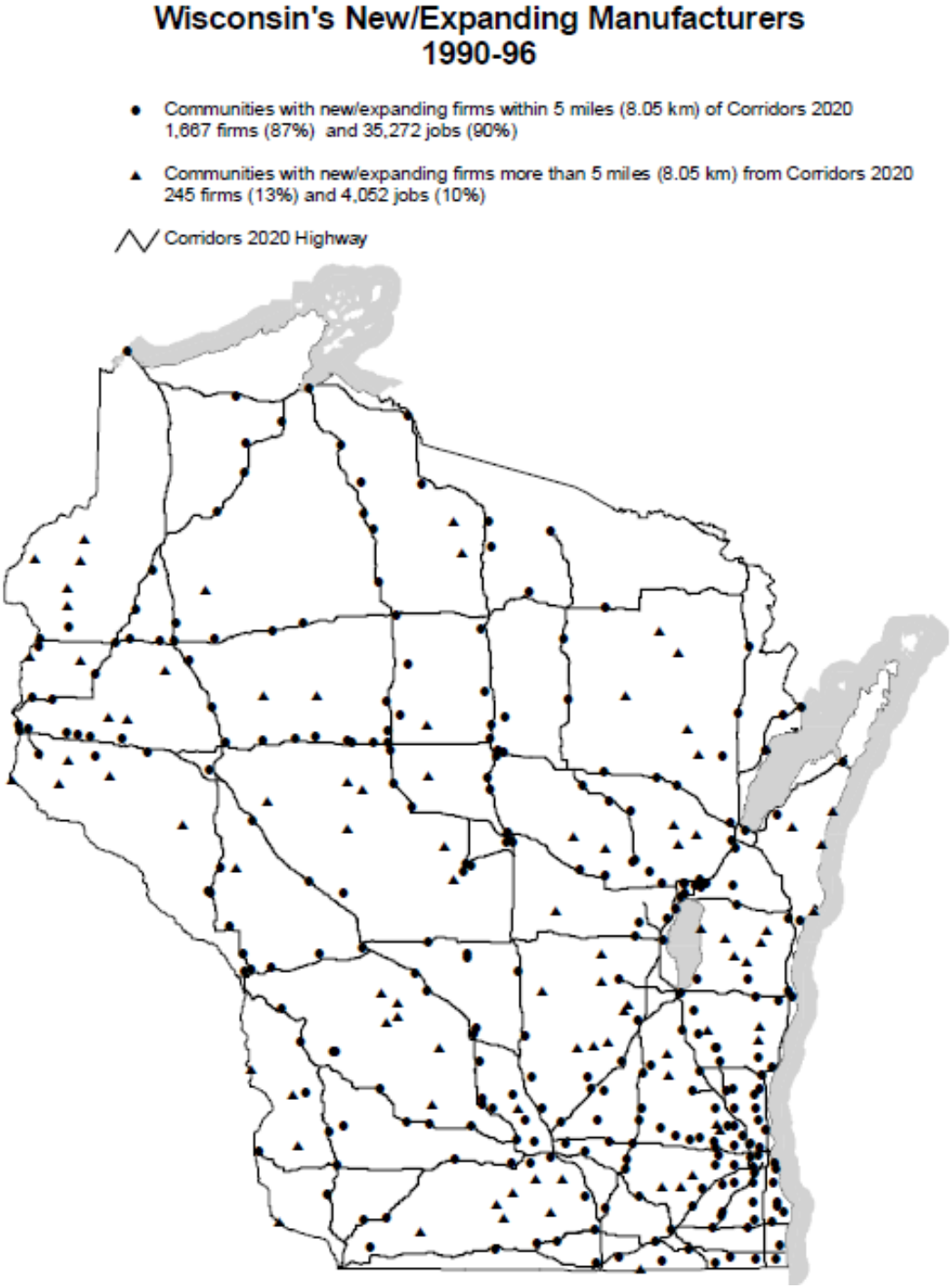
Data availability was initially a challenge, but over time, the tools and data have been purchased and applied to provide better information on all the modes, including freight.

The staff of economists include one dedicated technical lead, two full-time freight analysts, and several part-time staff dedicated to geographic information system (GIS) and modeling. Each staff person also tracks the trends for different modes, as they all have different global and national trends for growth.

The key lesson learned is that it is very important to make the case for why transportation is important to the economy. Once state legislators and the governor are provided evidence for business locating close to transportation corridors, it is an easy sell to support transportation investments.

Figure B.7 is an example of "making the case" for transportation investments. It graphically represents the results of a Wisconsin study that found that 87 percent of all new and expanded manufacturing businesses were in communities located within five miles of a Wisconsin 2020 corridor route, accounting for 90 percent of the new jobs generated during the 1990 to 1996 period.

Figure B.7 Manufacturing Jobs Attracted to Wisconsin 2020 Corridors



Source: Liat Lichtman, A Study of New and Expanding Manufacturing Plants in Wisconsin during 1990 to 1996: Analysis of New and Expanding Manufacturing Plants along Wisconsin's Highway Transportation Corridors.

C. Regression Models Used for the Bay Bridge Toll Evaluation

Table C.1 Estimated Regression Model of Factors Influencing Peak-Peak High-Occupancy Vehicle (HOV) Volumes, January 2009 to May 2011[a]

	B	Beta	T	Prob.
HOV toll (in dollars)	-.296	-.828	-9.590	.000
BART peak ridership	-.652	-.148	-2.056	.052
Unemployment rate (percent of workforce)	-.199	-.074	-0.921	.367
Gasoline price (mean, in dollars)	-.133	-.109	-1.109	.279
Spare Air Day (0/1)	.041	.119	1.846	.078
Number of days in month (relative to 30)	.662	.118	1.821	.082
Constant	20.645	–	4.984	.000

Summary: N = 29; F = 41.00; Prob. = .000; and R^2 = 0.918.

[a] Dependent Variable = HOV Traffic Volume. All variables expressed as natural logarithms, except HOV toll.

Table C.2 Estimated Regression Model of Factors Influencing Peak-Peak Traffic Volumes, January 2009 to May 2011[a]

	B	Beta	T	Prob.
Average toll (in dollars)	-.233	-.403	-2.399	.031
BART peak ridership	-.520	-.306	-1.339	.032
Gasoline price (mean, in dollars)	-.072	-.179	-1.125	.272
Bridge closures (0/1)	.085	.340	-2.122	.014
Number of days in month (relative to 30)	.824	.384	3.092	.005
Constant	21.040	–	7.692	.000

Summary: N = 29; F = -0.96; Prob. = .000; and R^2 = .684.

[a] Dependent Variable = Total Peak-Period Traffic Volume, including multi-axle vehicles and motorcycles. All variables expressed as natural logarithms.

Table C.3 Estimated Regression Model of Factors Influencing Total Monthly Traffic Volumes on San Francisco Bay Bridge, January 2009 to May 2011[a]
In Thousands

	B	Beta	T	Prob.
Average toll (in dollars)	-.103.60	-.241	-1.208	.240
BART, average fare (in dollars)	2,032.73	-.335	1.261	.220
Unemployment rate (percent of workforce)	-122.62	-.351	-2.029	.055
Attendance at events in AT&T Stadium (in thousands)	0.324	.366	2.652	.015
Bridge closures (number of days in month)	.84.73	-.499	-4.375	.000
Number of days in month (relative to 30)	2,537.81	.363	2.997	.007
Constant	-4,358.36	–	-0.936	.359

Summary: N = 29; F = 10.14; Prob. = .000; and R^2 = .734.

[a] Dependent Variable = Total Monthly Bay Bridge Traffic Volume, Including motor vehicles, multi-axle vehicles, and motorcycles.