
Special Report



Washington Research Council

October 15, 1996

The ABC's of RTA Analysis of Benefits and Costs

Overview and Conclusions

According to a benefit-cost analysis prepared by ECONorthwest, the costs of the proposed RTA plan exceed benefits by more than \$2.4 billion. An alternative analysis by ECONorthwest, using more optimistic benefit estimates, most taken directly from RTA reports, shows costs still exceeding benefits by nearly \$1 billion.

In preparing the analysis, ECONorthwest tested the significance of key benefit variables. Most of the difference can be explained by four critical factors: the value of travel time, the amount of travel time savings for system users, the travel time savings for drivers of private vehicles, and the determination of the "base case" against which RTA performance is compared. Each of these is discussed in more detail below. However, in no case did changes in these factors influence the estimate by more than 16 percent.

As Richard Zerbe and Dwight Dively, professors at the University of Washington and authors of a textbook on benefit-cost analysis, write, "Decisions are made by decision makers, and benefit-cost analysis is properly regarded as an aid to decision-making and not the decision itself."

We hope that this "aid to decision-making" adds value to the RTA debate during its final weeks.

Background

The value of benefit-cost analysis in evaluating major public works projects is well-established. Most economists endorse the technique. Yet, legitimate questions are often raised regarding the elements of the analysis and its apparent "green eyeshade" or bean-counting focus on only those consequences of public spending amenable to measurement. Both supporters and critics of the approach worry about the inclusion of all relevant costs and benefits, the ability to foresee accurately the effects of public policy choices and the treatment of intangible benefits.

In the ECONorthwest report, the research was supported by an exhaustive inventory of benefits and costs, relying heavily on the work of the RTA's staff, consultants and Expert Review Panel. Uncertainty has been acknowledged; frequently, a range of reasonable assumptions is tested in order to capture the potential variation. In this *Special Report*, intangible benefits are ignored (they are addressed in ECONorthwest's longer report); the primary transportation costs and benefits have been assigned monetary values.

About this Report

*In our July 8 Special Report, **Regional Transit Again**, we suggested that the 1995 RTA proposal failed “because the majority of voters believed that the benefits of the system did not justify the costs.” Ultimately, each voter performs a kind of benefit-cost analysis. Such analyses are generally subjective, “inside the voting booth” appraisals of the tax burden coupled with a reflexive endorsement or rejection of the project goals. Other times, there is a more systematic attempt to quantify the benefits and measure them against the costs, both to the individual taxpayer and to the region as a whole.*

With the RTA proposal, we have an unusual opportunity to apply economic reasoning to the region’s largest, locally-supported public works project. In undertaking this effort, we have worked with ECONorthwest, a prominent and well-regarded regional economics, finance and planning firm, which had previously prepared a preliminary assessment of the proposal for Emory Bundy (cited in our July Special Report).

We agreed to sponsor the research, with publication of the findings contingent upon our acceptance of the quality and objectivity of the work. That standard has been satisfied. The RTA reviewed an early draft of the ECONorthwest report and provided detailed written feedback addressing methodology, data and assumptions. Academic peer review was provided by nationally-recognized economists (referenced on page 9), as well as Washington Research Council Economist Dr. Kriss Sjoblom.

This Special Report is drawn from ECONorthwest’s larger analysis prepared for the Washington Research Council. In addition, we have considered the comments of the RTA, many of which resulted in revisions in the original ECONorthwest draft. Where there is major substantive disagreement, it is noted in this report. The ECONorthwest report is available by contacting our office at (206) 467-7088 or (800) 294-7088 (in-state).

Our final criterion in deciding to publish was simple: Will publication of the results enhance public understanding of the issue? We concluded that the information provided by this analysis represents an important contribution to public evaluation of the regional transit plan.

The focus of the analysis has been on accurate measurement of transportation performance. ECONorthwest attempted to capture likely changes in travel time, in mode of transportation (car, bus, train), and in cost of system operation. In some cases, their estimates vary from those endorsed by the RTA staff.

An additional critical factor is the discounting of future costs and benefits to a present value. Because \$1 today is worth more than \$1 received at some future date, it is important to account for the timing of costs and benefits. Discounting to present value at a social discount rate, which is like an interest rate, is the method generally accepted by economists and policy analysts.

Benefits

All benefits are based on a fully implemented RTA system in 2010, using 1995 dollars.

As Figure 1 shows (on page 3), the list of benefits expected in 2010 with the RTA plan is extensive. The first column presents the RTA’s “mid-point” estimates of benefits; the second column presents the ECONorthwest estimate. Although ECONorthwest and RTA disagree on many of the factors involved in calculating these benefits, in only four cases are the differences large enough to affect the overall estimate of net benefit (or cost):

- travel time savings for system users;
- reduction in vehicle miles traveled,
- travel time savings for drivers of private vehicles; and
- increased mobility for commercial vehicles.

**Figure 1. Estimates of Transportation Benefits in 2010
as Developed by the RTA and ECONorthwest**

| Types of Benefits | RTA Mid-range Est. (\$M/yr) | ECO Northwest Est. (\$M/yr) |
|---|--|--|
| Travel time savings for system users | 98 | 65.6 |
| Parking cost savings for system users | 13 | 14.2 |
| Auto operating/ownership cost savings | 19 | 24.2 |
| Travel time savings for drivers of private vehicles | 86 | 7.8 |
| Reduction in required employer-provided parking | 14 | 11.1 |
| Increased mobility for commercial vehicles | 13 | 0 |
| Improvements in transit system reliability | 7 | 6.6 |
| Increased rail freight mobility | NQ | NQ |
| Transportation benefits for special events at Kingdome and baseball stadium | NQ | 2.3 |
| Safety benefits of direct access to center HOV lanes | NQ | NQ |
| Improve road system reliability | NQ | Unlikely |
| New people moving capacity | NQ | Double Count |
| Preservation of transit travel times through dedicated right-of-way | NQ | Double Count |
| Improving transit mobility for "choice" and "dependent" riders | NQ | Double Count |
| Total Quantified Benefits | 250 | 131.8 |

NQ: Not Quantified

Source: RTA, Appendix C, Table 8; RTA Technical Memo, July 18, 1996; ECONorthwest calculations

Travel time savings for system users. For riders, the primary benefit associated with transit investment is a reduction in travel time. Figure 2 shows the significant reductions in travel times identified for the proposed RTA plan. ECONorthwest accepts the RTA staff estimates of reduced travel time, but disputes the value placed by them on the time saved.

According to ECONorthwest, most studies have found that people value their in-vehicle travel time at about half their wage rate. With an average regional wage rate of \$16, then, the value assigned to time saved would be about \$8 per hour. ECONorthwest notes that the Puget Sound Regional Council (PSRC), however, uses a mode choice model with an implied value of time at 25 percent of the region's wage rate. The RTA staff estimate the value at \$12 per hour, citing a study by the Texas Transportation Institute (TTI) which values travelers' time at \$12.17 per hour. As Figure 1 shows, the ECONorthwest approach results in an annual estimate of benefits of \$65.6 million; the RTA estimates the value at \$98 million.

Vehicle miles traveled. The RTA and ECONorthwest disagree on the effect of the transit plan on vehicle miles traveled (VMT) in the region. This difference is not explicitly identified in Figure 1, because the savings

in VMT feed into other benefit estimates, such as auto operating and ownership and travel time savings for drivers of private vehicles. Figure 3 reports the RTA estimates and the ECONorthwest revision. The projected annual reduction in VMT is based on estimates of new transit ridership, average trip length and average vehicle occupancy. ECONorthwest accepts the benefit estimates for express bus ridership and the background transit network (increased transit use because of general system improvements), but substantially reduces estimates for commuter and light rail.

Figure 2. Time savings

| | <i>Carpools & Vanpools</i> | <i>Bus Riders</i> | <i>Rail Riders</i> | <i>Total</i> |
|---|--------------------------------|-------------------|--------------------|--------------|
| Daily Time Savings (minutes) | 380,000 | 350,000 | 1,050,000 | 1,780,000 |
| Annual Time Savings (millions of hours) | 1.6 | 1.5 | 5.1 | 8.2 |
| Annual Value of Savings (millions of 1995 \$) | \$19.2 | \$18.0 | \$61.2 | \$98.4 |
| Implied Time Savings per Transit Boarding | n.a. | 5.7 min | 8.5 min | n.a. |

Source: RTA Appendix C, Tables 3 and 4.

Figure 3. Estimates of New Riders

| | <i>Express Bus</i> | <i>Commuter Rail</i> | <i>Light Rail</i> | <i>Background Transit Network*</i> | <i>Total</i> |
|----------------------|--------------------|----------------------|-------------------|------------------------------------|--------------|
| Daily New Riders | | | | | |
| • RTA | 14,000 | 5,000 | 32,000 | 15,000 | 66,000 |
| • ECONorthwest | 14,000 | 1,000 | 24,000 | 15,000 | 54,000 |
| Annual New Riders | | | | | |
| • RTA | 4 mil | 1 mil | 10 mil | 4 mil | 19 mil |
| • ECONorthwest | 3.5 mil | 0.3 mil | 6 mil | 3.8 mil | 13.6 mil |
| Annual VMT Reduction | | | | | |
| • RTA | NA | NA | NA | NA | 127 mil |
| • ECONorthwest | 23.3 mil | 5.3 mil | 25 mil | 25.3 mil | 78 mil |
| Average Trip Length | 8 | 25 | 5 | 8 | NA |

* This is attributed to the combined effect of greater transit system connectivity and reinvestment of bus hours.

Source: RTA Appendix A: New Riders; ECO Northwest.

With respect to commuter rail, the RTA staff projects that 40 percent of commuter train riders would be new transit users. This figure appears high to ECONorthwest, because of the similarity between express bus service and the planned commuter rail line. They point to an earlier RTA study, *Central Corridor Justification Project*, which estimated that only 7.4 percent of light rail riders would be “new riders,” or in other words, not current transit users shifting from one transit mode to another (like bus to rail). Stating that this same estimate ought to apply to commuter rail, ECONorthwest adjusts the RTA staff estimate of 5,000 new riders downward to 1,000.

Similarly, ECONorthwest questions the new rider estimate for light rail. These numbers have varied, as elements of the plan changed in the months preceding its formal adoption. Earlier estimates for the slightly smaller transit system assessed in the *Central Corridor* analysis projected about 19,200 net new daily riders for light rail. For the larger project, general travel time savings and ridership increased by 24 percent, but new riders increased by 67 percent, according to the RTA. ECONorthwest found this level of increase inconsistent and reduced the new rider estimate for light rail from 32,000 per day to 24,000. RTA stands by their estimate of 32,000.

In total, ECONorthwest cuts the estimate of annual new riders from 19 million to 13.6 million and lowers the estimate of VMT reduction from 127 million to 78 million. While the magnitude of the difference appears large, the reduction in VMT made by ECONorthwest has minimal impact on the net benefit calculation (see discussion of travel time savings below).

Travel time savings for drivers of private vehicles. Here the disagreement between ECONorthwest and the RTA is substantial, with ECONorthwest reducing the RTA estimate of the value of travel time savings from \$86 million to \$7.6 million. The primary reason cited by ECONorthwest relates to the measure of benefit associated with a reduction in miles traveled. ECONorthwest notes that the RTA calculation resulting in the \$86 million savings assumes that VMT reductions generate an average benefit of \$0.68 per mile. ECONorthwest assigns a VMT benefit of \$0.10 per mile, an estimate based on modeling done for the PSRC.

Economists differ on the appropriate estimate for congestion costs, although no study has been cited which places the figure close to the RTA estimate of \$0.68. (The RTA staff critique addressed the general cost of congestion, rather than the benefit per mile of VMT reduction.) ECONorthwest cites a literature review conducted by Todd Litman of the Victoria Transport Policy Institute, from which Litman recommends an estimate of \$0.17 for reductions at rush hour. Since not all new riders will come out of the peak commute traffic, ECONorthwest estimates the average benefit to be lower. Previous ECONorthwest work for the PSRC used a range of from \$0.07 to \$0.12.

Without any change in VMT (i.e., accepting the higher RTA staff estimates), the drop from \$0.68 to \$0.10 would reduce the travel time savings benefit from \$86 million to \$13 million.

Increased mobility for commercial vehicles. While the RTA staff estimates a benefit to commercial drivers of \$13 million per year, ECONorthwest states the benefit is minimal and values it at zero. In its critique of the earlier ECONorthwest draft, the RTA challenged the reduction, citing a previous ECONorthwest paper for the Puget Sound Regional Council which calculated substantial benefits (nearly \$5 billion) to commercial traffic from transit improvements. ECONorthwest responds that these benefits were based upon the PSRC transportation model which ignores latent demand (new drivers replacing transit users on the road). Much of the earlier ECONorthwest paper is devoted to a critique of the model. If new drivers replace current drivers who have been diverted to transit, then there is no substantial improvement in mobility for commercial vehicles.

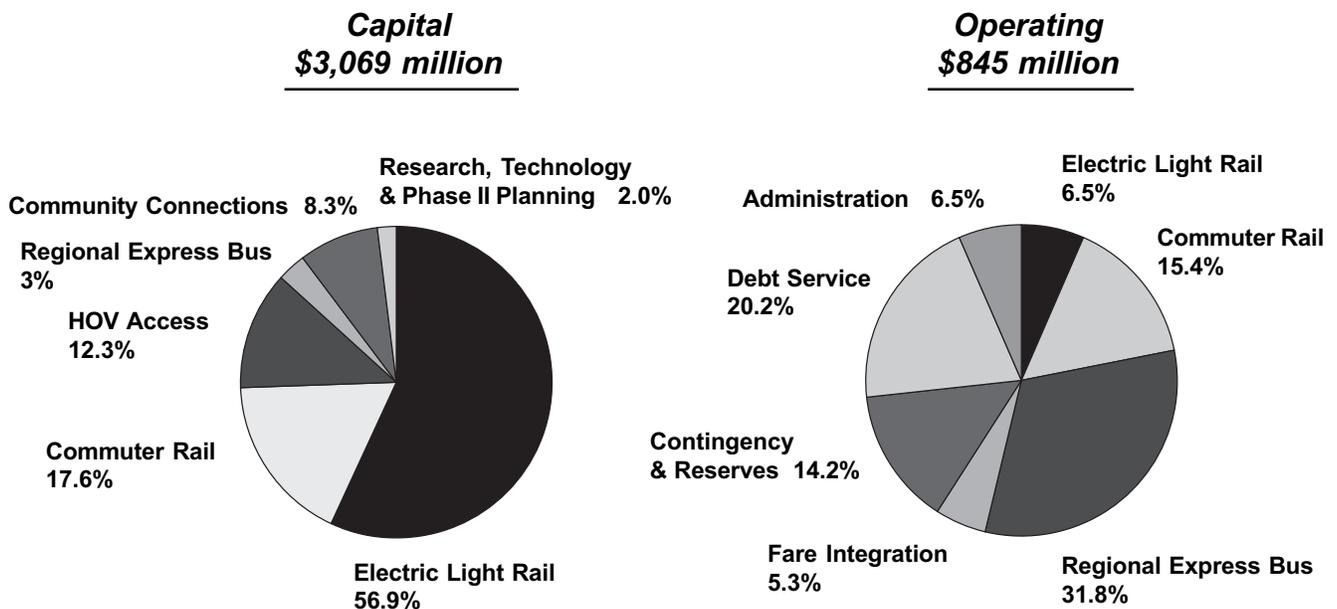
Costs

Of the \$3.9 billion investment planned by RTA over the next ten years, about \$3,069 million is in capital spending with the additional \$845 million associated with operating costs. About 46 percent of the investment, and more than half the capital spending, is associated with electric light rail. Figures 4 and 5 illustrate. In presenting the cost figures, ECONorthwest uses the full cost, including the \$727 million which will be supported by federal funding; this is an approach the Washington Research Council believes to be reasonable, if not essential. The RTA, in its critique, notes that local taxpayers are paying \$2 billion in new taxes, with the balance to be paid for with grants and bonds financed over thirty years.

With respect to capital costs, ECONorthwest accepts the RTA estimates, which were examined by the RTA's Expert Review Panel. The RTA has estimated operating costs as if the system were fully operational today; ECONorthwest also accepts those estimates. Growth in operating costs over time remains a significant issue.

Data from the Federal Transit Administration shows that the national average real operating costs per passenger mile increased by 4 percent per year for bus and 7.2 percent for light rail between 1990 and 1994. That continues a trend which has shown bus operating expenses per passenger mile increasing 4 percent annually over the past fifteen years. Most of the growth can be attributed to higher labor costs. With tighter fiscal constraints on public budgets, these increases are likely to slow over the next decade.

Figures 4 and 5. **Total Ten Year Costs (1997 to 2007) of the RTA Plan**



Source: RTA Appendix A, p. A-2.

Critical Assumptions

The analysis requires some assumptions about future system performance. In particular, three assumptions have a measurable impact on the estimate of net benefit. ECONorthwest evaluated changes in the benefit level over time, fluctuation in the operations and maintenance cost growth rate, and the implications of assessing RTA performance against the Transportation Systems Management plan. In addition, the discount rate used to estimate present values of future costs and benefits must be determined, as well as the residual value of the RTA estimate. Each of these factors is discussed below.

Benefit Growth Rate. The system is assumed to be fully operational in 2010. To calculate the benefits to be received from 2010 to 2030, it is necessary to estimate benefit changes over time. RTA had previously published a forecast which showed benefits beyond 2010 growing with the region's population (about 1.6 percent annually). Since then, they have determined that the data are not sufficient to support an estimate. ECONorthwest has tested a range of estimates from a positive 1.5 percent to a negative 1.5 percent and uses a base estimate of zero; that is, benefits will remain constant over time.

Operations and Maintenance Cost. As mentioned above, transit systems have experienced real O&M cost increases averaging about 4 percent. The more conservative ECONorthwest estimate of 1 percent real growth appears reasonable.

TSM Factor. Most of the benefit estimates developed for the RTA proposal compare it to the Transportation Systems Management (TSM) plan developed in the early 1990s by the RTA's predecessor agency, the Regional Transit Project. A December 4, 1991 Technical Memorandum, "Preliminary TSM Ridership Forecasts," explains that the TSM plan "provides a baseline against which the cost-effectiveness of major transitway or rail investments will be evaluated." The estimates presented by RTA staff on the benefits of the proposed system are all relative to this TSM alternative. As a result, the RTA staff contends, the benefits published in their system plan are understated.

The critical issues appear to be 1) whether the benefits associated with the TSM plan overlap those associated with the RTA proposal, and 2) whether passage of the RTA plan will allow the region to avoid costs that would otherwise have been incurred. In *Sound Move*, published by the RTA May 31, 1996, the TSM forecast is said to represent "transit ridership growth due to population and employment increases, completion of the state Transportation Department's core HOV system and those transit service increases that can be paid for within existing transit agency tax sources."

Using the TSM plan as a reference base does not appear to compromise the analysis and no adjustment in benefit level is made. Nonetheless, ECONorthwest tests a "TSM Factor" increasing and decreasing the total benefit identified by the RTA by 20 percent (1.2 - 0.8).

Discount rate. The discount rate is an integral part of the benefit-cost analysis, is analogous to the rate of return for private investments and represents income that might have been anticipated from an alternative investment. The rate selected by ECONorthwest is 4 percent, which is similar to the rate recommended by the General Accounting Office (and about the same as the interest rate charged by banks to their preferred customers). The federal Office of Management and Budget has recommended real discount rates of as high as 10 percent. The lower rate tends to favor investments like the RTA which incur most of their costs early and realize most of their benefits in the future.

Residual value. The benefit-cost calculations span the years 1997-2030. At the end of this period, the

RTA will own capital assets whose value must not be ignored. RTA estimates that these assets will be worth \$1.4 billion. ECONorthwest accepts this estimate and includes this residual value as a benefit in the final year.

Results of the Analysis

Figure 6 reports final estimates of benefits and costs. All numbers are in 1995 dollars.

ECONorthwest calculates the discounted value of benefits over thirty years to be \$2,085 million. These benefits were calculated from the information for 2010 shown in the right column in Figure 1. In addition the benefit in the final year includes a residual value of \$1.4 billion for RTA investments.

The discounted value of costs over this period is \$4,549 million. In addition to the initial capital and annual operating costs discussed earlier, capital renewal costs, as estimated by RTA, are included in years after 2007.

Figure 6. Evaluation of Transportation Benefits and Costs of the RTA over Thirty-Four Years

| | <i>ECONorthwest Assumptions</i> | <i>RTA Assumptions</i> |
|---------------------------------------|---------------------------------|------------------------|
| Benefits (millions) | \$2,085 | \$3,626 |
| Costs (millions) | \$4,549 | \$4,611 |
| Net (millions) | (\$2,464) | (\$985) |
| Rate of Return | -4.2% | 1.1% |
| Annualized Cost per New Transit Rider | \$13,028 | \$9,314 |

Assumptions

- 2010 benefits as listed for RTA and ECONorthwest in Fig. 1
- Benefit growth rate: 0%
- Residual value: \$1.4 billion
- Capital, operating and renewal costs from RTA estimates
- Maintenance cost growth rate: 1%
- Discount rate: 4%

Over the thirty-four years, discounted at 4 percent, costs exceed benefits by \$2,464 million, in ECONorthwest's estimation. Looked at differently, the rate of return on the "investment" in RTA is -4.2 percent per year.

Alternately, benefits and costs are calculated relying on the benefits in 2010 as estimated by RTA staff and reported in the left column of Figure 1. In this case benefits are \$3,626 million while costs are \$4,611 million. The slightly higher costs here reflect the RTA staff's higher ridership estimates.

Thus, based on the RTA estimates of the benefits in 2010, the costs of the plan exceed benefits by \$985 million. The rate of return is a positive 1.1 percent. In other words the project returns \$985 million less than required to "break even" with a 4 percent discount rate. Had the discount rate selected been 1.1 percent, the net benefit would have been zero.

ECONorthwest has tested the degree to which changing key assumptions varies the analysis. The results of this "sensitivity analysis" are presented in Figure 7 (on page 9). Variables tested include the benefit growth rate, growth in O&M costs, the estimated value of time, the benefits of reduced VMT and a factor representing benefits attributable to the RTA as a result of the TSM investment.

Figure 7. Sensitivity Analysis on Key Assumptions

| Assumptions | <i>Most Favorable to RTA</i> | | <i>Least Favorable to RTA</i> | |
|--|------------------------------|---------|-------------------------------|--------|
| | 1 | 2 | 3 | 4 |
| Benefit Growth Rate | 1.50% | 0.75% | -0.75% | -1.50% |
| % Change in Net Benefit | 5.5% | 2.6% | -2.4% | -4.6% |
| O & M Growth Rate | 0.0% | 0.5% | 1.5% | 2.0% |
| % Change in Net Benefit | 8.4% | 4.4% | -4.9% | -10.4% |
| Value of Time | \$12.00 | \$10.00 | \$6.00 | \$4.00 |
| % Change in Net Benefit | 15.9% | 8.0% | -8.0% | -15.9% |
| Driver Benefits per VMT Reduction | \$0.17 | \$ 0.14 | \$ 0.07 | \$0.03 |
| % Change in Net Benefit | 2.3% | 1.3% | -1.0% | -2.3% |
| TSM Factor | 1.2 | 1.1 | 0.9 | 0.8 |
| % Change in Net Benefit | 10.7% | 5.3% | -5.3% | -10.7% |

Expert Review

ECONorthwest asked for an expert review of their analysis. The review statement follows:

We have reviewed the analysis conducted by ECONorthwest of the Regional Transit Authority's proposed system plan. The methods and assumptions used in this analysis are consistent with those that professional transportation economists would use in analyzing projects of this type. The estimates of the range of net transportation benefits of the plan are reasonable.

- Paul Courant, Chair, Economics Department, University of Michigan
- Jose Gomez-Ibanez, Derek Box Professor of Urban Policy and Planning, Graduate School of Design and John F. Kennedy School of Government, Harvard University
- John Kain, Visiting Professor, University of Texas at Dallas and Henry Lee Professor of Economics and Professor of Afro-American Studies, Harvard University
- Steve Fitzroy, Consultant and Former Director of Research and Forecasting for the Puget Sound Regional Council
- Anthony Rufolo, Professor of Urban Studies and Planning, Portland State University

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