Oregon Department of Transportation – Rail Division

Oregon Rail Study Appendix L

Rail Industry Return on Investment Calculations

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Executive Summary

This report was developed to quantify the indirect, or societal, benefits of freight and passenger rail. These benefits include improved air quality, reduced congestion, reduced highway maintenance costs, improved safety, and increased economic activity. This is not an economic model, but rather a menu of calculations that can be used in planning and prioritizing state investments.

Rail Return on Investment Calculations

Environment

- Every ton of freight shipped by rail reduces greenhouse gas emissions by 86 percent compared to moving the same freight by truck.

  Assumptions

  Trucks produce 134.4 grams of CO_2 per ton-mile.[1]

  Trains produce 18.6 grams of CO_2 per ton-mile.[1]

  Calculation

  134.4 – 18.6 = 115.8 / .906 = 86%

- Every ton of freight shipped by rail reduces fuel consumption by 62 percent compared to moving the same freight by truck.

  Assumptions

  Trains move 1 ton 413 miles on 1 gallon of fuel.[2]

  Trucks move 1 ton 155 miles on 1 gallon of fuel.[2]

  Calculation

  413 – 155 = 258 / 413 = 62%

- Every ton of freight shipped by rail uses 91 percent less energy than the same amount of freight moved by truck.

  Assumptions

[1]Forkenbrock, David J., External Costs of Truck and Rail Freight Transportation," University of Iowa, 1998, Page 27.
[2] Center for Ports and Waterways & Texas Transportation Institute, "A Modal Comparison of Domestic Freight Transportation Effects on the General Public," November 2007, Pages 36-38.
http://www.nationalwaterwaysfoundation.org/study/public%20study.pdf

Trucks use 3,717 BTUs per ton-mile.[3]

Trains use 338 BTUs per ton-mile.[3]

Calculation

3,717 – 338 = 3,379

3,379 / 3,717 = 91%

- Intercity passenger trains use 47 percent less energy than if the same passengers traveled by passenger vehicles.

  Assumptions

  Passenger vehicles use 3,222 BTUs per passenger-mile.[3]

  Intercity passenger rail uses 1,719 BTUs per passenger-mile.[3]

  Calculations

  3,222 – 1,719 = 1,503 / 3,222 = 47%

Congestion

- The average freight train in Oregon reduces delay by 3 minutes on 139 miles of highway.

  Assumptions

  18,403,000,000 ton-miles moved by truck originated in Oregon in 2002.[4]

  132,229,000 tons moved by truck originated in Oregon in 2002.[4]

  1 train equals 280 trucks.[5]

  1 truck equals 3 passenger cars.[6]

  10% of truck trips are during peak traffic hours.

  Average highway speed is 50 miles per hour.

  84 passenger vehicles = 1 mile per hour speed increase from 50 to 51 miles per hour.[7]

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[3] Pacific Northwest National Laboratories, "The Value of End-Use Energy Efficiency in Mitigation of US Carbon Emissions," November 2007, Table A.14.
[4] FHWA, Bureau of Transportation Statistics, "Commodity Flow Survey 2002: State Table 3." http://www.bts.gov/publications/commodity_flow_survey/2002/states/excel/table_03.xls
[5] Association of American Railroads, "Overview of U.S. Freight Railroads," January 2007, Page 6.
[6] Transportation Research Board, National Research Council, "Highway Capacity Manual," 2000, Exhibit 23-8.
[7] University of Florida, "Highway Capacity Software Version 4.1B," McTrans, July 2002, Freeways Operational Analysis Module.

Calculations

18,403,000,000 / 132,229,000 = 139 miles per trip

1 train = 280 trucks x 3 passenger vehicles = 840 passenger vehicles x 10% operating in peek periods= 84 passenger vehicles

139 miles per trip / 50 miles per hour = 2.78 hours x 60 minutes = 167 minutes

139 miles per trip/ 51 miles per hour = 2.75 hours x 60 minutes = 164 minutes

167 minutes – 164 minutes = 3 minute reduction in travel time

Highway Maintenance

- The average freight train in Oregon reduces highway pavement costs by $645.

Assumptions

68,918,405 tons moved by rail in Oregon in 2002.[8]

1 train equals 280 trucks.[5]

1 truck makes an average of one 139-mile trip per day, 300 days per year.

1 truck carries 18 tons.[9]

On average 33 trains travel through Oregon each day.

1 truck per day costs $3.73 per mile per year of pavement maintenance (an average of $0.012 per day per mile).[10]

Calculations

68,918,405 tons / 300 days = 229,728 tons per day moved by rail

229,728 tons per day / 18 tons per truck = 12,763 trucks per day.

12,763 trucks x 139 miles = 1,774,010 truck vehicle miles traveled (VMT) per day

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[8]Association of American Railroads, "Railroad Service in Oregon 2006," June 2008. http://www.aar.org/PubCommon/Documents/AboutTheIndustry/RRState_OR.pdf

[9] Cambridge Systematics, "Portland/Vancouver Truck O-D Survey, Portland Freight Data Collection Phase II, Task 10 Summary Report," March, 2007, Table 4.4

[10] Gibby, A. R., Ryuichi Kitamura, Huichun Zhao, "Evaluation of Truck Impacts on Pavement Maintenance Costs," UC-Davis, 1990 (converted to 2008$). http://pubs.its.ucdavis.edu/publication_detail.php?id=1008.

1,774,010 truck VMT per day / 33 trains per day = 53,758 truck VMT per day per train.

53,758 x $0.012 per mile = $645 reduced highway pavement maintenance needs per train.

- Every dollar invested in rail capacity saves $10.60 in highway user costs including travel time, incidents, vehicle operating costs and highway maintenance.

  Assumptions

  For $60 billion invested in rail = $635 billion in benefits to highway users.[11]

  Calculations

  $635 Billion / $60 Billion = $10.60

Safety

- Current freight train volume in Oregon prevents 442 highway accident injuries each year.

  Assumptions

  68,918,405 tons moved by rail in Oregon in 2006.[8]

  1 train equals 280 trucks.[5]

  1 truck makes an average of one,139-mile trip per day, 300 days per year.

  1 truck carries 18 tons.[9]

  Oregon accident injury rate = 83 injuries per 100,000,000 VMT or 0.83 injuries per 1,000,000 VMT (MVMT).[12]

  Calculations

  68,918,405 tons on rail / 18 tons per truck = 3,828,800 trucks per year if rail freight switched to trucks

  3,828,800 trucks per year x 139 miles per trip / 1,000,000 = 532 truck MVMT per year

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[11] American Association of State Highway Transportation Officials, "Freight Rail Bottom Line Report," 2002, Page 67.
[12] ODOT, "Annual Performance Progress Report Fiscal Year 2006-07," September 2007, Page 15-23. http://www.oregon.gov/ODOT/CS/PERFORMANCE/docs/2007ODOTAnnualPerformanceReport.pdf

532 truck MVMT x 0.83 injuries per MVMT = 442 injuries per year avoided

Jobs and the Economy

- Each $1 million spent by the state on rail projects creates 46 new jobs.

  Assumptions

  Pennsylvania: $93,500,000 invested in rail = 9,694 jobs.[13]

  AAR: $1,000,000,000 invested in rail = 20,000 jobs.[14]

  Virginia: $245,000,000 invested in rail = 3900 jobs.[15]

  Calculations

  9694 / 93.5 = 104 jobs per $1,000,000

  20,000 / 1000 = 20 jobs per $1,000,000

  3900 / 254 = 15 jobs per $1,000,000

  104 + 20 + 15 = 139 / 3 = 46 average jobs per $1,000,000

- Each ton of freight shipped by rail saves Oregon shippers an average of $34.47 in shipping costs per trip.

  Assumptions

  18,403,000,000 ton-miles moved by truck originated in Oregon in 2002.[16]

  132,229,000 tons moved by truck originated in Oregon in 2002.[4]

  Rail shipping costs = $0.022 per ton-mile.[17]

  Truck shipping costs = $0.27 per ton-mile.

  Calculations

  18,403,000,000 / 132,229,000 = 139 miles per trip

  $0.022 x 139= $3.06 rail shipping costs per trip

  $0.27 x 139 = $37.53 truck shipping costs per trip

  $37.53 - $3.06 = $34.47 reduction in shipping costs

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[13] American Society of Civil Engineers, "Report Card for Pennsylvania's Infrastructure," 2006. http://www.pareportcard.org/graphics/PARail2006.pdf

[14] Association of American Railroads.

[15] Tucker, Matthew M., Virginia Department of Rail and Public Transportation, January 2008. presentation. http://sfc.state.va.us/pdf/transportation/2008/012208%20DRPT%20presentation.pdf

[16] FHWA, Bureau of Transportation Statistics, "Commodity Flow Survey 2002: State Table 3." http://www.bts.gov/publications/commodity_flow_survey/2002/states/excel/table_03.xls

[17] Bureau of Transportation Statistics, USDOT, "National Freight Transportation Statistics, Table 3-17: Average Freight Revenue Per Ton-mile," 2001. http://www.bts.gov/publications/national_transportation_statistics/excel/table_03_17.xls