6-2-1977

City Club of Portland Bulletin vol. 58, no. 02 (1977-6-2)

City Club of Portland (Portland, Or.)
REPORT ON

CHOICES FOR METROPOLITAN PORTLAND'S

MASS TRANSIT SYSTEM

The Committee: J. Barron Fitzpatrick, M. David Hooff, Nancy E. Stevens, Hubert E. Walker, Arno Reifenberg, Chairman.

Published as a Special Edition, Vol. 58, No. 2

(This report published with the financial assistance of the Portland City Club Foundation).

"To inform its members and the community in public matters and to arouse in them a realization of the obligation of citizenship."
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLOSSARY OF TERMS</td>
<td>6</td>
</tr>
<tr>
<td>I. INTRODUCTION</td>
<td>7</td>
</tr>
<tr>
<td>II. BACKGROUND</td>
<td>7</td>
</tr>
<tr>
<td>A. History of public transportation in Portland</td>
<td>7</td>
</tr>
<tr>
<td>B. State and national influence</td>
<td>7</td>
</tr>
<tr>
<td>C. Transportation planning</td>
<td>8</td>
</tr>
<tr>
<td>D. Summary</td>
<td>9</td>
</tr>
<tr>
<td>III. TRI-MET OPERATIONS</td>
<td>9</td>
</tr>
<tr>
<td>A. Operating costs</td>
<td>10</td>
</tr>
<tr>
<td>B. Vehicle mode</td>
<td>10</td>
</tr>
<tr>
<td>IV. DISCUSSION</td>
<td>11</td>
</tr>
<tr>
<td>A. Expansion of the system</td>
<td>11</td>
</tr>
<tr>
<td>1. Funding expansion</td>
<td>11</td>
</tr>
<tr>
<td>2. Service area and routing</td>
<td>12</td>
</tr>
<tr>
<td>B. Modes of transportation</td>
<td>12</td>
</tr>
<tr>
<td>1. The Diesel Bus</td>
<td>13</td>
</tr>
<tr>
<td>2. The Trolley Bus</td>
<td>13</td>
</tr>
<tr>
<td>3. Bus Lanes and Light Rail</td>
<td>17</td>
</tr>
<tr>
<td>a. Banfield Corridor</td>
<td>17</td>
</tr>
<tr>
<td>b. Sunset and Oregon City Corridors</td>
<td>18</td>
</tr>
<tr>
<td>4. Other modes</td>
<td>18</td>
</tr>
<tr>
<td>V. CONCLUSIONS</td>
<td>19</td>
</tr>
<tr>
<td>VI. RECOMMENDATIONS</td>
<td>20</td>
</tr>
<tr>
<td>APPENDIX A — Persons Interviewed</td>
<td>22</td>
</tr>
<tr>
<td>APPENDIX B — Bibliography</td>
<td>23</td>
</tr>
<tr>
<td>APPENDIX C — Total Transportation Costs</td>
<td>25</td>
</tr>
<tr>
<td>APPENDIX D — Energy Efficiency for Various Transit Modes</td>
<td>25</td>
</tr>
<tr>
<td>Map at centerfold — Transit Corridor System from CRAG Interim Transportation Plan for the Portland-Vancouver Metropolitan Area (June 1975)</td>
<td>14, 15</td>
</tr>
</tbody>
</table>
GLOSSARY OF TERMS

**Arterial Street**—A main road with many branches usually having controlled access in the form of traffic lights or stop signs.

**Dial-a-bus**—A system permitting a person to summon a mass transit vehicle by telephone.

**Exclusive busways**—Roadways made available for use only by buses.

**Express lanes**—Roadway lanes available only to vehicles designated to deliver fast and direct service (either separated or non-separated from parallel roadways).

**Grade separated**—Vehicle rights-of-way not located adjacent to and/or at same level as other parallel roadways.

**Grid system**—Mass transit routes appearing when viewed on a map like a spiderweb.

**H.O.V. Lanes**—(High Occupancy Vehicle) Public roadway lanes restricted to use by vehicles carrying a minimum number of passengers.

**Jitney**—Small bus, van or auto for public passenger use for a small fare usually operated on a regular route.

**Light rail transit**—Modernized street cars for public passenger use, electrically powered, running on and guided by steel rails.

**Mass transit**—Facilities capable of transporting the public, usually through or across a city.

**Multi-modal**—A mass transit system incorporating more than two types of passenger carrying vehicles.

**ODOT**—Oregon Department of Transportation (formerly the Oregon State Highway Commission).

**Park and Ride**—Automobile parking lots located in the suburbs for use by people utilizing their personal autos and mass transit.

**People Movers**—Devices or machines capable of transporting people such as moving sidewalks and automated capsules.

**Radial System**—Mass transit routes appearing, when viewed on a map, like the hub and spokes of a wagon wheel.

**Rapid transit**—Mass transit utilizing equipment and systems providing faster than average transportation.

**Timed transfer**—Coordinated movement of mass transit vehicles that minimize the time required by riders to board another vehicle.

**Transit corridors**—Lanes (separated or not from other traffic lanes) devoted primarily to use by mass transit vehicles.

**Tri-Met**—Tri County Metropolitan Transportation District of Oregon (Consisting of Multnomah, Washington and Clackamas counties).

**Trolley bus**—Electrically powered bus usually receiving its energy from overhead wires.
REPORT ON

CHOICES FOR METROPOLITAN PORTLAND'S

MASS TRANSIT SYSTEM

To The Board of Governors,
The City Club of Portland:

I. INTRODUCTION

This committee was established by the City Club Board of Governors in June 1975 "in order to better inform members of the City Club and the public about the major options for the future Portland metropolitan area transit system." The committee was asked to study the existing mass transit system and make appropriate recommendations. Specifically, the committee was asked: 1) Should the region's mass transit system be expanded, and if so, when? 2) Which of the following modes should be used: a) more diesel buses on existing roadways; b) exclusive busways; c) rail transit; d) trolley buses. 3) Are other mass transportation modes better suited for our area?

The seven-member committee organized in late September, 1975 and thereafter met almost weekly to listen to witnesses with a wide background in all phases of transportation planning and operation. A list of persons interviewed is included in Appendix A of this report. A selected bibliography is appended as Appendix B. With a study grant funded by the City Club Foundation and Lewis and Clark College, the committee obtained the very able assistance of a research intern, Mr. Joseph Cortright, a graduate in economics from the college.

II. BACKGROUND

A. History of public transportation in Portland

Privately owned mass transportation companies first appeared in Portland in 1882. At first, service was provided by horse-drawn vehicles. These were later supplanted by street cars. Gasoline powered buses appeared in the 1920s. In 1936, 141 trolley buses were purchased.

In 1946, Portland's transportation system carried over 125 million passengers. This service was provided by 141 trolley buses, 124 street cars and 220 motor buses. Street cars, except for interurban lines, were discontinued in February 1950. The largest fleet of vehicles was used in 1951 with 191 trolley buses and 303 motor buses. That system carried 68.5 million passengers. Later in the 1950s trolley buses were dropped from the system and the interurban rail lines discontinued. Annual ridership decreased to 15,395,074 in 1970.

Until 1969, Portland's mass transit system had been operated by private companies under a license granted by the city. In 1969 the license was terminated and the service taken over by Tri-County Metropolitan Transportation District of Oregon (Tri-Met) established under ORS Chapter 267.

Other than for the interurban rail lines, suburban transportation was provided by four "Blue Bus" lines, the earliest of which started operating in 1932. In 1969 these lines carried three million passengers. In September 1970 these buses were sold to Tri-Met.

B. State and national influence

The period after World War II saw a vast growth in automobile traffic. Responding to this trend, the Federal-Aid Highway Act of 1956 declared it to be the intent of Congress that the federal interstate highway system be completed in 13 years. The federal share of the cost of the interstate system was increased from 50 percent to over 90 percent.
Even before this increased national impetus to highway building, the goal of the Oregon State Highway Commission (now Oregon Dept. of Transportation) from 1920 to 1960 had been to complete a state and local highway system. This was reflected in the state constitution which dedicated the gasoline tax fund to highway-related projects.

A connection between the private automobile and basic individual freedom had been established as implicit national policy. Everyone should have a car, and government should meet the demand for roads.

Winds of change began to appear in the 1960s. In 1964 Congress passed the Urban Mass Transportation Act, providing loans and grants for urban mass transportation systems. The protection of man's environment began to be recognized as of vital importance. In 1963 Congress, through the Clean Air Act, began to take steps to control and abate air pollution. As later amended, the Act required the establishment of national air quality standards and their enforcement by the states. (A plan to increase Tri-Met ridership by 50 percent was the major component in Oregon's Clean Air Plan to meet federal air quality standards.) The national Environmental Policy Act of 1969 required increased examination of environmental effects of federal programs.

In the 1960s Congress also began to emphasize the need for regional planning. The 1962 amendment to the Federal Highway Act conditioned the approval of interstate highways in urban areas on a continuing comprehensive planning process carried on by states and local communities. After July 1, 1965, the Department of Housing and Urban Development (HUD) and the Federal Highway Act required that any further aid to local communities be related to a program of comprehensive planning.

C. Transportation planning

Local transportation planning was done by the various cities and counties in our area until 1959 when the Portland-Vancouver Metropolitan Transportation Study (PVMTS) was initiated by the Oregon State Highway Commission. The study area included Clackamas, Multnomah, Washington and Clark (WA.) counties and their principal cities. In 1966 the Columbia Region Association of Governments (CRAG) was formed as a voluntary organization. It became a statutory body in 1973.

CRAG, using PVMTS, adopted a master transportation plan for our area in 1969. This plan contemplated the construction of an extensive highway and street system to meet the needs of 1990 at a cost of over $1 billion. In 1973, under contract with CRAG, DeLeuw, Cather and Company published the 1990 Public Transportation Master Plan. It called for improvement of the public transportation system.

In May of 1973 Governor McCall announced the formation of a task force to re-examine transportation decision-making in the Portland metropolitan area. The report of this task force, released in January, 1975, recommended abandonment of the PVMTS plan with its reliance on extensive highway additions, and recommended replacement thereof by bus corridors and light rail corridors at an estimated cost of $114,600,000.

CRAG had been charged by the legislature with adopting regional land use planning goals and objectives and preparing a plan interrelating all land uses including transportation. In June 1975 CRAG adopted its Interim Transportation Plan for the Portland-Vancouver metropolitan area. This plan recommends express transit facilities in the Barbur, Sunset, Vancouver, Banfield and Oregon City corridors. A map of the proposed transit corridor system appears at the centerfold of this report. The regional mass transit system envisioned by this plan is designed to carry more than ten percent of all regional travel by 1990, with the capacity for large increases beyond that year for little additional investment. The system currently carries three to four percent. The plan recognizes that auto travel will continue to play a vital role in the movement of people throughout the region and recommends the augmentation and maintenance of the present highway system. But it calls for mass transit projects to solve problems that autos cannot solve, such as moving commuters efficiently during peak hours and providing mobility to those who do not drive.
After the adoption of the interim plan, studies of the five corridors began. The Barbur corridor will have a single express bus lane (inbound in the morning, outbound in the evening). Work on this corridor is expected to start soon. The plans for the Vancouver corridor have been finished but the committee has been told of no proposals to implement these plans. One reason may be that the work would be done on the Oregon side (with Oregon money) while the chief beneficiary would be Clark County in Washington. The committee has been told that Clark County may be reluctant to spend money to encourage more travel into Oregon.

The Oregon Department of Transportation (ODOT) is completing its studies of the Banfield corridor. The department is considering seven alternatives, from doing nothing to building separated busways at a cost of $84 million. At Tri-Met's recommendation, CRAG has voted to include as an additional alternative the construction of a light rail (street car) system in the corridor, at a cost varying between $79 and $83 million. (None of these costs include the cost of the additional vehicles, buses or light rail, to be operated in the corridor.) Public hearings on a draft environmental statement regarding this corridor will be held later this year.

Studies of the alternatives for the Sunset and Oregon City corridors are not as far advanced as the Banfield study, although public hearings on draft environmental statements are scheduled for sometime in 1978.

In looking at these studies, and particularly the costs of the projects, it should be remembered that, as the result of the abandonment of the Mt. Hood Freeway, over $200 million of federal money is presently available to be spent on local needs, to be matched by about $40 million in state and local money. This federal contribution will decrease with inflation.

D. Summary

In the years after World War II, the tri-counties’ population rose from 620,000 in 1950 to 940,000 in 1975. Highways were being improved with ample federal funds. Yet mass transit was left to fend for itself. Patronage shrank until in 1969 Portland’s Rose City Transit Co. carried about a tenth of the number of passengers it had carried in 1946. Official planning in the area looked for greater accommodations for the automobile. When Rose City Transit Co. asked the City Council for permission to raise its fare from 35¢ to 40¢, the Council refused and terminated the franchise, effective June 12, 1969. In response to this emergency, the Oregon legislature authorized the creation of transit districts and Tri-Met was formed.

III. TRI-MET OPERATIONS

Tri-Met took over an ailing mass transit system and in a few years has been able to upgrade it considerably with the help of additional subsidies not available to the previous operator. It has purchased new buses and almost doubled its ridership since 1969. It plans to increase annual ridership to about 55 million in 1979. This is the level at which the Portland system (not including the suburban) operated in 1953.

Tri-Met has adopted a dual strategy to meet its 1980 goals: 1) a program of immediate improvements—bus shelters, park-and-ride facilities, express programs—designed to attract riders and make the most effective use of the present system; 2) major capital improvements to accommodate long-range needs — express corridors, suburban transit stations, downtown Portland transit mall.

Currently, Tri-Met operates 70 routes with a diesel bus fleet of 530 vehicles. The

---

1Your committee corresponded with a number of western cities about the mass transit situation. Three of them, Seattle, Houston and Denver, carried about the same number of passengers as did Portland last year. San Francisco carried 164 million and Vancouver, B.C. 90 million. Seattle, Denver and Vancouver had fares varied by zones. Seattle and Houston have a radial transportation system in which, like Portland, all traffic radiates out from a central downtown area. All received operating and capital subsidies, either through taxation or through state or federal grants.
system is a radial one oriented towards the downtown Portland area with a few cross-town lines. Fourteen percent of its passengers are grade and high school students, ten percent senior citizens and disabled, and 76 percent other adult fares. Recently, when the Vancouver bus line went out of operation, Tri-Met contracted with the city of Vancouver to carry on that service until June 30, 1977.

A. Operating costs

Until the middle of 1976, Tri-Met's fare had been 35¢. (Earlier there had been a zone fare structure, with suburban trips more expensive than intra-city rides.) The fare is now 40¢. Tri-Met's goal is to have fares cover 40 percent of its "operations department" costs. (In fiscal year 1975-76 fares represented 41 percent of this cost.) Operations department costs are made up of transportation services and maintenance costs. These are variable costs which Tri-Met can use to compare the cost-effectiveness of each of its lines. According to Coopers & Lybrand, Tri-Met's accountants, total operating costs would also include the following: insurance and safety, pensions and disability, depreciation, administrative and general costs. Last fiscal year fares represented 30 percent of these total operating costs. (See Appendix C for further observations about costs.) The remainder of Tri-Met's costs are paid by the .5% payroll tax on employers in the tri-county area and by federal operating subsidies. Capital improvements are largely funded by the federal government.

Tri-Met's five-year plan, adopted in 1973, projects operating costs to rise from $25 million in 1975-76 to $40 million in 1979-80. By that time, if not before, operating costs are expected to exceed funds available from current levels of fares, payroll taxes and federal subsidies.

As can be seen from these figures, Tri-Met's plans are largely controlled by its fiscal constraints. It has therefore adopted a series of goals and service criteria which enable it to plan both expansion and contraction of service levels. This program provides guidance for incremental changes in service in the short run. To anticipate the impact of long-range changes or the inclusion of a new transportation mode or express corridor into the system, Tri-Met applies fiscal impact analysis to proposed capital investments to determine what effect the payment of its share of capital improvements will have on Tri-Met's budget. This analysis allows Tri-Met to determine whether it can afford to expand or change its system.

B. Vehicle mode

All vehicle acquisitions by Tri-Met so far have been in the form of diesel buses. Some public sentiment has been expressed that Tri-Met should have considered the purchase of trolley buses or light rail vehicles. CRAG's interim plan suggests the study of these modes. A 1947 DeLeuw, Cather report recommended the abandonment of street cars because of declining patronage, but the retention of trolley buses on the most heavily travelled routes. The report found the operating costs of trolley buses to be lower than that of motor buses. The trolley bus was more expensive to purchase but, in view of its longer life, depreciation costs were thought to be equal. The only financial drawback was the high cost of the electrical distribution system which precluded the use of trolley buses on any except the more important transit routes. DeLeuw, Cather did another trolley bus study for Tri-Met in 1976 and found trolley buses to have certain advantages, except for higher costs. Tri-Met decided to take no action on trolley buses until a decision on the use of light rail in the transit corridors had been made. A preliminary light rail study of the Banfield corridor was given to Tri-Met early this year. This study found that, over the assumed 40-year life of the project, the cost of the light rail alternative would be about the same as the cost of the most expensive busway alternative.
A. Expansion of the system

At the time the Board of Governors framed the first charge for your committee, the basic decision to expand our mass transit system had already been made. The PVMTS freeway plan had been scrapped and CRAG's Interim Transportation Plan had been adopted which called for public transit to play a key role in our transportation system for 1990.

All of our transportation planning since World War II had been based on the assumption that there was going to be a great increase in metropolitan population which required a corresponding increase in the transportation system. The tri-counties' population grew 50 percent between 1950 and 1975. Projections indicate that it will double the 1950 figure by 1990 and reach 1.3 million by the year 2000.

The PVMTS plan would have reduced automobile travel times throughout our region and made peripheral areas more accessible, as the construction of past highways had already done. New suburban developments would be encouraged which would be difficult and expensive to serve with mass transit, with the result that again increased automobile travel would be needed. Additional automobiles would bring about a more congested downtown, more pressure on parking there and elsewhere, greater air pollution and far greater dependence on expensive and uncertain supplies of energy. Within the city of Portland, some portions of existing neighborhoods would have to be sacrificed to provide rights-of-way for new freeways, thus depressing the city tax base and dislocating some persons who might otherwise be served by mass transit.

This plan was abandoned in 1975. The energy crisis of 1973 made us realize the automobile was an imperfect means of transportation. We had also become increasingly aware of the automobile's negative influence on the environment, contributing to pollution and poor land utilization.

One alternative is to cease expansion of our transportation system and rely on existing facilities. Congestion would increase, perhaps dramatically, over a period of years as the population rises. This would raise travel times throughout the region and make urban areas relatively less attractive. It would encourage people to live close to where they work, or businesses to move away from downtown areas to locations more easily accessible to workers and customers.

The goal of local transportation planners, as recently expressed by Tri-Met's board chairman in a City Club address, has been to provide a transportation system which gives people the freedom to choose where they want to live. Tri-Met's five year plan is to increase daily average ridership by 100 percent from fiscal year 1973-74 to fiscal year 1978-79, a numerical increase from 72,500 to 145,000 originating riders per day. At this writing, Tri-Met is ahead of schedule.

Although the decision to expand our mass transportation system has already been made by planners and politicians, it has not been whole-heartedly accepted by the people of our area. After the end of World War II, the implicit policy of our state and nation was to encourage the use of the private automobile. Much of the growth of our economy is related to the automobile and construction industries. The automobile gives all of us a freedom to travel that man has never known before. Our love affair with the automobile resulted in a drastic decline in use of public transit, in flight to the suburbs and in increased air pollution.

1. Funding expansion

When Tri-Met was established, it was decided to obtain a public subsidy. Of the various sources of revenue available, Tri-Met's board decided to utilize the one which was least likely to be challenged in a public vote — the employer's payroll tax. When the people were asked last year to shift a part of this tax more directly to themselves through an added tax on automobiles, the measure was roundly defeated. (At the same time, they voted against an increase in the gasoline tax, this to enable the state, counties and cities to keep the existing highway system in repair.)
The importance of gaining public support for increased mass transit is underscored by Tri-Met's projections. Tri-Met's operating expenses are expected to increase to about $40 million in fiscal 1980-81 and Tri-Met's goal calls for farebox revenues to be held to 40 percent of its operations department costs. If Tri-Met is to operate at the level planned for 1980-81, even without including the increase in buses or other vehicles necessary for the traffic volume in later years, additional revenue must be found, either from the farebox or through another approach to the voters (unless the federal government is able and willing to lend more support).

It is idle to speculate whether Tri-Met made the right decision in 1969 not to go to the voters then for the needed funding. The area had just adopted the PVMTS traffic plan which encouraged reliance on automobiles, not public transit. Politicians believed that we were not ready to make the financial commitment the people of the San Francisco Bay area made in order to build BART.

2. Service and routing

While the decision had been made by public officials to place greater reliance on mass transit, to expand the fleet of vehicles and attract more riders, another decision relating to expansion of mass transit was made in 1969 when Tri-Met was established. That decision was to encompass all of the tri-county area in the district. Yet it is a fact that Tri-Met does not now serve all of this area and does not plan to do so by 1990. Mass transit is economical only if supported by an adequate number of riders. The outlying areas of the three counties do not have sufficient population for viable mass transit routes. Present and proposed land use planning does not contemplate the location of a sufficiently large number of people in those areas. On the other hand, mass transit is needed for transportation between parts of Clark County, Washington and the Portland metropolitan area. Current land use planning efforts should be used to delineate Tri-Met's boundaries.

Most of the planning by various public groups concerned with mass transit has concentrated on traffic between the suburbs and downtown Portland. Tri-Met took over a system oriented towards downtown Portland, a radial system. A few experiments have been conducted with north-south lines in east Portland, and one line connects northeast Portland with the northwest without going through the downtown area. Recently, Tri-Met announced a realignment of bus lines in the southeast area, and the City of Portland is working on an arterial street system which may require further realignment of Tri-Met routes.

Consideration is being given to incorporating a grid pattern into the radial system so that people can go to their destination without always having to pass through downtown Portland. Such a system would require transfers. A transfer system works well only if people do not have to wait long for connecting vehicles. Such a system is in operation in larger cities such as Toronto, where 70 percent of transit travel does not go downtown. But Toronto's grid system requires buses to run about every ten minutes. This may be too expensive for Portland. Therefore, the timed transfer concept might be appropriate for our area, a method which is being used in Portland at night when most buses arrive at the same time in the downtown area, making transfers more convenient. This concept might be expanded by converging vehicles at strategic locations in the area, perhaps once every thirty minutes. Such a timed transfer system reportedly has worked well in Edmonton, which in 1975 had a population of 452,000. If a combination grid and timed transfer were instituted in our area, the result would be that a few lines would develop that would be relatively heavily travelled, especially lines that head downtown. These are the lines which would qualify for a transportation mode other than diesel buses. Tri-Met is currently studying a possible grid system.

B. Modes of transportation

When your committee first talked with public officials late in 1975, very few expressed any interest in a mass transit mode other than the diesel bus. But several existing plans
and studies made reference to other modes. In 1973 a Public Utility Commissioner’s study recommended the consideration of light rail on five transportation corridors. The Governor’s task force mentioned the light rail alternative. Tri-Met in 1974 made an analysis of light rail, diesel bus and trolley bus. CRAG’s interim plan mentions trolley buses and light rail. Citizen groups — Citizens for Immediate Adoption of Trolley Buses, Sensible Transportation Options for People, and Transit Research of Oregon — kept the issue of alternative modes before the public and in large measure contributed to the decision of Tri-Met to engage consulting firms to study the trolley bus and the light rail vehicle.

1. The Diesel Bus

When Tri-Met took over Portland’s mass transit system, it acquired a fleet of gasoline and diesel powered buses. It decided to upgrade service quickly by purchasing new diesel buses and retiring the gasoline buses.

The acquisition cost of a diesel bus is less than that of a trolley bus or light rail vehicle. The diesel is the most flexible mode of mass transit, needing no wires nor rails. Its technology is well-known in the United States.

Diesel buses emit far less carbon monoxide than automobiles carrying the same number of passengers. They do emit hydrocarbons, nitrogen oxides, particulates and sulfur dioxides, and they are noisy and smelly. Hydrocarbon and nitrogen oxide produce smog in sunlight. Nitrogen oxides and sulfur dioxides may affect the lungs but not enough is known of their effects to make any positive statements. At present diesel buses comply with all federal and state environmental standards except perhaps for noise.

The state Department of Environmental Quality (DEQ) recently informed your committee that in 1975 federal carbon monoxide standards for eight-hour averages were exceeded in Portland 51 times and in 1976, 26 times. The federal standard for particulates was not exceeded in 1975. The results of 1976 testing for particulates have not been summarized.

2. The Trolley Bus

Portland’s experience with the trolley bus has been described in an earlier section of this report. In 1947 DeLeuw, Cather rendered a report on transit modernization and traffic improvements in Portland. It stated that each type of vehicle has a function for which it is best suited. The decision must be made not alone on investment or operating costs, but also on the basis of public acceptance, flexibility and possibility of future changes. The report found: 1) trolley bus operating costs were lower than the cost of operating gasoline buses; 2) the initial capital cost of trolley buses was higher, but the trolley bus had a longer life than the gasoline bus and 3) trolley buses necessitated an additional expense, the electrical distribution system.

The 1976 DeLeuw, Cather report on the trolley bus traced its history in the United States. In 1951, there were 6,500 such buses. Today, less than 700 are in use. On the West Coast, San Francisco operates 300 trolley buses; Seattle has 58 and plans to double that number; Vancouver, B.C. uses 300 trolley buses. The report discusses Portland's experience. Rose City Transit Co. (Tri-Met's predecessor) said unfavorable operating costs and lack of flexibility led to the abandonment of the trolley system. No mention was made of the earlier DeLeuw, Cather report.

The 1976 report discusses the experiences of other West Coast cities. Seattle reports that both diesel and trolley buses should cost about the same to operate. There are high capital costs, but over-all, trolley buses cost only one cent per mile more to operate than diesel buses. The San Francisco view is that trolley buses are cheaper to maintain and operate but that the maintenance of overhead wiring makes diesels marginally cheaper system-wide. Vancouver, B.C. believes that maintenance costs are potentially at or below diesel costs and operation costs are comparable.

The report finds the big advantage of trolley buses to be a reduction in reliance on oil and beneficial impacts on noise and air pollution. It states that trolley buses are considered
INTERIM TRANSPORTATION PLAN
FOR THE PORTLAND-VANCOUVER METROPOLITAN AREA
Adopted by the Board of Directors of CMAA, Resolution 88D 750604 June 18, 1975.

COLUMBIA REGION ASSOCIATION OF GOVERNMENTS
JUNE 1975
The connection of the Transit Corridors System with the Downtown Transit Mall will be the subject of a special report.
to operate most competitively in congested areas and on hills where their environmental
and performance advantages show their greatest effect. The disadvantages are greater
over-all costs, visual pollution from overhead wiring and less flexible routing.

The trolley bus has a number of operating efficiencies: it decreases dependence on
fossil fuels, it is quieter than the diesel bus and it causes minimal air pollution. The
acknowledged advantages of trolley buses must be weighed against the disadvantages.
Routing of trolley buses presented a problem to Portland when the city changed its
transportation system in the 1950's to the one-way street system in the downtown area.
This system is well-established. Soon the city is expected to adopt its arterial street policy.
Tri-Met is analyzing a possible grid system. Once these plans are developed, a number
of major lines will undoubtedly develop. Little rerouting should be needed if the trolley
system is well-planned and integrated into the city's entire transportation system.

Visual pollution presents a second, and to many people, very important problem. This,
like noise, is a factor not subject to expert analysis but depending largely on people's
individual preferences. In many areas of the city, the addition of trolley wires to existing
utility lines will cause no great change in scenery. Trolley buses should be located
where the addition of trolley wires is aesthetically acceptable because of existing wiring or suf-
cient foliage cover. Photographs examined by your committee of trolley operations in
other cities in the U.S. and abroad lead the committee to believe that this visual problem
can be minimized.

The DeLeuw, Cather report's chief objection to the trolley bus is its costs. According
to DeLeuw, Cather, the total operating and annualized capital cost difference between
100 diesel buses and 100 trolley buses is over $2 million a year.

The committee believes that this figure is not the true difference Tri-Met would
experience were it to operate 100 trolley buses. The committee has studied DeLeuw,
Cather's technical reports used by that company in writing its final report. The data in
these technical reports support an operating and maintenance cost advantage in favor of
the trolley bus more than double that estimated by DeLeuw, Cather in its final report.
In addition, the final report includes a ten percent interest factor on capital expenditures
as one of the costs. Use of a seven percent or ten percent interest factor is required
in applications for federal funding, but Tri-Met pays no interest on federal grants and
thus this interest factor is not a cost to Tri-Met. Use of the seven percent rate would
reduce DeLeuw, Cather's cost differences by $500,000.

Further, the committee has constructed a fiscal analysis based on the DeLeuw, Cather
data and allowing for inflation. Inflation is important in estimating yearly operating
expenses but a comparatively minor factor in capital expenditures since these usually
occur first. According to this analysis, if the 100 trolley bus system had been instituted
last year, by 1982-83 the trolley bus would be cheaper to operate on an annual basis than
the diesel bus. By 1985-86, the total eight-year operating cost of the trolley bus would
be less than the eight-year operating cost of the diesel bus. The committee has submitted
this analysis to Tri-Met for comment, but has received no reply.

Tri-Met decided to take no action on the trolley bus matter until its study of the light
rail question has been completed. Recent trends highlight the danger of relying exclusively
on diesel buses:

a) It is likely that we will witness a reduction in the available oil supply and that the
cost of this energy source will continue to rise dramatically;

b) There is no evidence of an imminent technological breakthrough in automobile
engines which would replace the internal combustion engine and, accordingly, cars will
continue to rely exclusively on oil-based fuel.

c) Although the Northwest is becoming aware that hydroelectric power is in short
supply, dependent on the weather and becoming more expensive, it is, in the committee's
opinion, a more reliable source of energy than oil, which is a truly finite resource. A 100-
bus trolley system is estimated to require a peak power demand of six megawatts (MW).
The Alumax aluminum plant planned for eastern Oregon will consume some 274 MW.
PGE indicated to DeLeuw, Cather that the trolley bus requirement is not a significant level of power demand. The hydroelectric peak potential of Bull Run dam is 36-38 MW. It is assumed that mass transit use of electricity will have a very high priority.

As we reported above, flaws can be found in the DeLeuw, Cather economic analysis. However, in the committee's opinion, the important consideration is not whether one or the other system is more cost-effective.

Environmental and energy considerations support the adoption of a trolley bus system on heavily travelled and hilly routes. Substitution of trolley buses for diesels in the downtown mall area would alleviate many complaints from those who are exposed to diesel bus fumes and noise.

3. Bus Lanes and Light Rail

CRAG's Interim Transportation Plan recommends two grade-separated bus lanes in the Banfield and Sunset corridors and light rail in the Oregon City corridor. Recently CRAG added light rail as an alternative for the Banfield corridor. This action was taken on the basis of a preliminary report done for Tri-Met by two planning consultant firms. The consultants will have additional recommendations to make later on. They indicated to the committee that they thought there might be sufficient traffic to warrant light rail in the Sunset corridor if that corridor were lengthened.

a. Banfield Corridor

ODOT, in charge of planning for the Banfield corridor, has recently made presentations of various alternatives for handling the expected increase in traffic flow from the area east of Portland. The arterial streets alternative would attract the most riders, require the smallest capital and operating costs and is thus most cost-effective. It would use a number of arterial streets to channel traffic downtown in the morning and back out in the afternoon, eliminate parking on the traffic-bound curb lane, and give priority to mass transit vehicles. Its disadvantages are that it would have an adverse impact on adjacent land values, would cause increased congestion on city streets, and lead to more accidents.

Another low cost alternative is a continuation of the existing high-occupancy vehicle (HOV) lanes on the Banfield freeway, extension to I-205 and construction of ramps to connect the lanes to Holladay Street. This would still require placing 70 through buses on city streets during peak hours.

Other alternatives have been advanced, including a separate busway or light rail, and would require a capital outlay of between $65 and $83 million. Of these, according to ODOT, the separate busway would attract the most riders and be least costly to operate. However, it would place the greatest number of buses on the mall downtown. According to ODOT, light rail would remove more buses from the downtown area than the other alternatives. ODOT has as yet made no estimate as to which of the alternatives is the most energy efficient. Tri-Met's light rail/diesel bus/trolley bus analysis compared the energy effectiveness of the diesel bus and light rail and found light rail to be nearly twice as efficient as the diesel bus. (See Appendix D)

Light rail is a name for a high grade street car system and must be distinguished from the far more expensive heavy rail systems such as BART (Bay Area Rapid Transit in San Francisco). Both Tri-Met's "Light Rail/Diesel Bus/Trolley Bus Analysis" of 1975, and its recent light rail interim report, found light rail operating costs to be lower compared to diesel buses when, as demand increases, cars may be coupled and still require only one operator. The reports did not compare the costs of light rail with trolley bus. Light rail emits no exhaust or fumes and its noise level is lower than that of diesel buses. Light rail is twice as energy efficient as the diesel bus and it does not rely on fossil fuels because it is electrically-powered. A light rail system of 100 vehicles was estimated by the PUC report to require five megawatts of power in the morning and evening. Portland's total daily use in 1973 was approximately 1,000 MW. Because of the greater passenger capacity of individual light rail cars, because the cars can be coupled and
because the headway between light rail cars can be less than between diesel buses, the light rail system has a greater capacity for future expansion than a comparable bus system.

On the other hand, light rail's initial capital costs are far higher than diesel bus costs; the system is dependent on rails and routes cannot readily be moved; and light rail derives its power through overhead wires.

Tri-Met's light rail study indicates that a double track line can be constructed from downtown Portland to Gresham at a cost of $83 million. A double track line to Gateway and a single track from there to Gresham would cost $79 million. In addition, the cost of equipment must be considered. Total capital needs for a multi-modal rail-bus system on the east side are estimated to range between $115 and $125 million, compared to $90 to $107 million for the all-bus alternative. According to Tri-Met's study, annual operating costs of light rail are expected to be lower than diesel bus costs because of the greater passenger capacity of the light rail vehicles. The total cost, capital and operating, of the light rail alternative over the assumed 40-year life of the project, would be the same as that of the separate busway project.

b. Sunset and Oregon City Corridors

ODOT has not completed its preliminary analysis of the Sunset corridor nor has Tri-Met finished its study of the Oregon City corridor. Westside traffic now coming to Portland over Canyon Road probably cannot easily be diverted to arterial streets, as the low-cost alternative for the Banfield corridor suggests. In 1975 the Sunset tunnel carried 70,000 cars at peak hours. That figure is expected to rise to 125,000 in 1990. The question before the planners is whether to attempt to meet this expected growth or whether to discourage trips downtown through land use policy or minimal road improvement and resultant traffic delays.

No consideration seems to have been given to the use of trolley buses on the Banfield or other corridors. The capital cost of a trolley bus system would be far less than that of the light rail system. DeLeuw, Cather in its trolley bus report found light rail to have advantages on lines having heavy patronage and requiring high operating speeds. Because cars can be coupled and still be operated by only one person, light rail can perform economically on lines with a substantial variation between peak and base patronage levels. DeLeuw, Cather states that in San Francisco several diesel lines are being considered for conversion to trolley lines, all of them well patronized lines in hilly or congested areas. However, the heaviest route (with 49,100 weekday trips) is scheduled for conversion to light rail.

In 1946, 50 percent of all trips to downtown Portland were made by mass transit. That figure is 18 percent now. By 1990 the population of our area is expected to be more than double the 1946 figure. In view of the population increase and the increase in the number of automobiles, we cannot again expect to deliver 50 percent of the people going downtown by mass transit unless special provision is made for transit vehicles.

Those making presentations about the Banfield corridor and the light rail alternative emphasize that all facts have not been sufficiently analyzed, that computers are being used daily to study various demand models. Even though CRAG has adopted an over-all transportation plan, its detailed components are being studied one at a time, and a number of alternatives, some at variance with CRAG's master plan, are being considered for each. This is being done at a time when the various jurisdictions in our area have not as yet adopted their own comprehensive land use plans. Before action can be taken on any of the plans, all the jurisdictions involved in the plan must approve, from the federal department of transportation through ODOT down to the affected counties and cities.

4. Other modes

The area's mass transit system consists not only of Tri-Met's buses. The private automobile, especially as it will be environmentally improved in the 1980's will continue to

2"HOV Test Period on I-80/N Near End," The Sunday Oregonian, April 17, 1977.
play an important part, and part of your committee's recommendation for emphasis on light rail is based on the fact that such a mode will give automobiles and other vehicles more space on our streets and highways. In the outlying, low-density areas, the private car is superior to expensive buses. The planners realize this and a number of park-and-ride stations are being planned. Carpoors or vans operated by employers for their workers render a significant service.

An important contribution is made by taxicabs. Jitney service on regular routes could be instituted where passengers could be picked up or dropped off for less than individual fare costs. Dial-a-bus (taxi) service could be utilized to bring travellers to central points where they could board public vehicles. Taxis could be used as substitutes for buses on lightly patronized routes and on any or all routes during low patronage hours. Your committee believes that Portland's taxicab operators would welcome these opportunities provided the arrangements were made economically feasible. Benefits could include better service for patrons, reduced consumption of fossil fuels and reduced operating costs.

We have studied other modes, such as "people movers" and monorail and are aware of subways and elevated trains. We believe the first two have not proved themselves sufficiently to justify consideration at this time. The last two are not cost effective in view of our anticipated population. The feasibility of water transportation on the Willamette and Columbia rivers should be explored in the future.

Special emphasis must be given to the transportation of the handicapped. Taxis or special vehicles are needed for wheel chair patients. Tri-Met has acquired special buses and is beginning to supplement the transportation services available to the area's handicapped.

V. CONCLUSIONS

1. There are three compelling reasons for a mass transit system for the Portland metropolitan area: a) to support neighborhoods and communities by preserving them through elimination of need for additional freeways; b) to conserve energy, which is possible if the average ridership per mass transit vehicle is significantly increased; and c) to contribute to dependable, convenient and comfortable movement of people and goods in the region by reducing the number of vehicles required.

2. In view of projected population growth, along with the public decision not to build any more major freeways, it is inevitable that the needs of our area must be served by a larger public transit system with the ability to expand as demand justifies.

3. Even though we should keep in mind direct economic costs, we must also be guided by consideration of other real social costs and benefits associated with transportation which usually are not quantified in terms of money such as environment and quality of life.

4. In the near future the diesel bus will continue to play an important part in the system because of its great flexibility, but should not be the only mode of public transit in use.

5. Electrically-powered trolley buses and light rail vehicles should be re-introduced into our mass transit system because:
   a) electric power may be substituted in this region for dwindling petroleum fuels;
   b) the electric motor is more energy-efficient and less polluting than the internal combustion engine;
   c) increased population densities projected for existing urban areas will support these higher capacity modes.

6. Our examination of the present radial pattern of mass transit routing leads us to conclude that it does not serve adequately the transportation needs of the metropolitan area. The mass transit system must provide ready access to all parts of our area rather than concentrate almost exclusively on delivering people to and from downtown
Portland. Our radial system should be modified to include a more extensive grid system.

7. A comprehensive transportation system must include reliance on existing modes, i.e., the private automobile, privately-owned taxicabs, and employer-operated vans and carpools.

8. Each mass transit proposal should be examined in the context of current land use plans and be compatible with a comprehensive plan that serves the transportation needs of the entire metropolitan area.

9. Although many options are proposed for an improved mass transit system, no plan can be implemented without evidence of public support. Our public leaders must make every effort to acquaint the people of this area with the need to plan and pay for an efficient, reliable and convenient mass transit system.

VI. RECOMMENDATIONS

1. The region's mass transit system should be expanded to serve more people.

2. Before any plan is adopted and the mass transit system expanded, the regional transportation plan should be governed by population density projections and conform to land use guidelines in effect for this region.

3. If jurisdictional problems can be surmounted, Tri-Met service should be extended to include densely populated areas of Clark County, Washington. Service should be limited where population density in the tri-county area is inadequate.

4. Tri-Met should integrate a grid system of routing with its present radial pattern.

5. Light rail or other electrically-powered vehicles should be given preference in the five corridors unless further study shows ridership will not justify their costs.

6. On hilly or heavily travelled routes, trolley buses, rather than diesels, should be used (Sandy Blvd., Foster Road, and N.W. 23rd-Medical School are prime possibilities).

7. A loop route of trolley buses through the downtown area connecting with some diesel bus routes and light rail routes on the edge of the downtown area should be established to prevent serious air and noise pollution problems in downtown Portland.

8. Other modes of public transportation such as taxicabs, vans and smaller buses should be integrated into our mass transit system.

9. A regional mass transit system should develop with the full knowledge and cooperation of the citizens of this area. Only they, through the fare box and through their tax dollars, make it possible to operate a viable transportation system. We recommend intensified efforts to make the public aware of:
   a) The amount of subsidy, both local and federal, that taxpayers are contributing to build and operate the system, and the social benefits derived from such expenditures;
   b) the objectives and potential benefits of an expanded mass transit system;
   c) the advantages, disadvantages and costs associated with the major transit options under consideration (i.e., trolley bus, light rail, separate busways);
   d) the need to make timely decisions on mass transit options;
   e) the need to pay for mass transit improvements that will best meet anticipated needs.

10. The Board of Governors of the City Club should appoint another mass transit committee in the near future to study some unanswered questions not covered in our study, including:
   a) Fare box rates: How much should mass transit users pay towards the costs of a ride? Should it remain public policy to keep fare box rates low with special discounts for students, senior citizens, etc.? Should the entire public subsidize mass transit, or only that portion which directly benefits from service?
c) Public vs. private operation: Should private companies be encouraged to supersede, compete with or complement Tri-Met by receiving subsidies?

If we accept the statements by the current federal administration regarding the severity of the energy shortage, and the necessity to substantially reduce our use of the automobile, we should also seriously consider whether a major mass transit system can be most efficiently operated by the public sector. Since major public subsidies will be required to finance such large systems, it may be more economically feasible to employ the private sector to operate mass transit, as has been the case with air travel. The committee recommends that the citizens of the Portland metropolitan area and the state of Oregon begin serious discussion and debate on this important question.

d) Use of mass transit: In a democratic society, how much direct pressure by government agencies, local, state and federal, do we place on people to use mass transit? How much indirect pressure? How much education is necessary to prepare people for either a gradual or drastic change inevitable with the diminishing resources of fossil fuels and the more stringent environmental standards imposed because of growing private auto use?

e) Costs and uses: The real and total costs of mass transit should be discussed such as average total cost per ride; average number of riders on buses at any and all times; data and comparison of fuel consumption per person riding mass transit versus private autos; and road space required per person travelling by private car vs. mass transit road vehicles.

Respectfully submitted,*

J. Barron Fitzpatrick
M. David Hooff
Nancy E. Stevens
Hubert E. Walker
Arno Reifenberg, Chairman

*Two other members—Michael Patterson and Stephen Janik—participated in earlier stages of the study, but were not active at the time the conclusions and recommendations were adopted.

Approved by the Research Board on May 5, 1977 for transmittal to the Board of Governors. Received by the Board of Governors May 16, 1977 and approved for publication and distribution.
APPENDIX A
PERSONS INTERVIEWED

Douglas Allen, member, STOP, CIAT, Banfield Transitway Citizens Advisory Committee; mass transit coordinator Sierra Club and Oregon Environmental Council legislative task force.

L. James Bergmann, Assistant General Solicitor, Union Pacific Railroad
Robert Blanchard, Superintendent, Portland School District No. 1
David Bragdon, student
Everett L. Brower, Manager, Radio Cab Company
Carl Buttke, private consulting engineer; formerly with DeLeuw, Cather & Co.
David B. Charlton, Mei-Charlton Industries
Donald E. Clark, Chairman, Multnomah County Board of Commissioners
L. B. Day, then Chairman, Land Conservation and Development Commission
Normandie Denney, Associated General Contractors
William Dirker, then Transportation Coordinator, City of Portland
Tom Donaca, Associated Oregon Industries
Gerald L. Drake, Senior Vice President, Wilbur Smith & Assoc. (consulting firm)
Jerry Egge, Associated General Contractors
Dick Emery, head, Financial Division, Tri-Met
Dick Etherington, Transportation Planning Director, CRAG
Charles Frost, Member, Board of Directors, Tri-Met
Rufus T. Fuller, Financial Secretary, Amalgamated Transit Union
Dick Granger, Clark County Commissioner
H. Lawrence Griffith, D.D.S., Transit Research of Oregon
William Hall, Director of Planning, Tri-Met
A. W. Hillborn, Asst. to vice president, Southern Pacific Railroad
Jim Howell, Chairman, Sensible Transportation Options for People (STOP)
Francis J. Ivancie, Commissioner, City of Portland
Larry Kocher, spokesman for handicapped citizens
Keith Lawton, CRAG transportation staff
John Matthews, OK Trucking Company
Stephen McCarthy, Asst. General Manager, Tri-Met
Betty Merten, consultant
Glen O'Dell, engineer, Seton, Johnson & O'Dell
Robert S. Orr, Public Projects Engineer, Union Pacific Railroad
Dave Paoli, Mass Transit Division, Oregon Department of Transportation (ODOT)
Dick Pokornowski, Vancouver City Councilman
Ray J. Polani, Chairman, Citizens for Immediate Adoption of Trolley Buses (CIAT)
Warren Post, planner, Tri-Met
Charles L. Sauvie, Associated Oregon Industries
Steven M. Siegel, City Planner, Portland
Carl Simons, engineer, Transportation and Air Quality Maintenance Planning, DEQ
Ted Spence, Planning Coordinator, Planning Section, ODOT
Richard Taylor, Business Manager, Oregon Lung Association
Nohad A. Toulan, director, Urban Studies Program, Portland State University
Tom Vanderzanden, CRAG transportation staff
Alan Webber, Executive Assistant to Mayor Neil Goldschmidt
APPENDIX B

BIBLIOGRAPHY

Portland Transportation Planning
——. Interim Transportation Plan, June 1975.
——. “Workshops on the Regional Comprehensive Plan.”
——. "Banfield Transportation Improvements—A look at the alternatives being considered as of December 1976."
TRI-MET. Goals and Service Criteria.

Highways, Automobile Transportation
Dawson, Russell. “Auto Subsidies and Related Costs.”

Trolley Buses and Diesel Buses
Polani, R. J. Remarks to the City Club of Portland. August 23, 1974.


Light Rail Transit


Papers from the National Light Rail Conference, Philadelphia, June 1975.

- G. R. Beetle, "LRT Construction Costs"
- Ronald DeGraw, "LRT Operating and Maintenance Costs"
- W. A. Jessiman & G. A. Hocus, "LRT Ridership Attraction"
- R. S. Morach, "Operating a Light Rail System"
- R. J. Langdorf, "Light Rail Permanent Way Requirements and Sources"
- W. H. Morris, "Comparison of Busway and Light Rail Concepts"
- T. E. Parkinson, "Light Rail System Evaluation"
- E. L. Tennyson, "Public Considerations of Economics and Marketing of Light Rail Transit"
- G. J. Thompson, "Light Rail Transit Social Costs & Benefits"
- J. W. Vigrass, "Physical, Operational and Performance Characteristics of the Light Rail Mode"
APPENDIX C
TOTAL TRANSPORTATION COSTS

According to Tri-Met and its audited financial statements for the 1975-76 fiscal year, ridership, operating costs and fuel consumption are as follows: There were 29,293,261 originating riders; buses traveled a total of 19,402,956 miles; average boardings per mile were 1.51 persons; and the length of the average trip per rider was 3.6 miles. Therefore, during the 1975-76 fiscal year, the average number of riders on any bus at any time was approximately five persons.

Total operating costs were $27,499,802. The average cost per mile was $1.42 (27,499,802 ÷ 19,402,956). The average cost to serve one rider was $1.02 ($1.42 x 3.6 ÷ 5). The cost of operating a private car for one person traveling 3.6 miles, at 15¢ a mile* is 54¢.

Tri-Met's buses averaged 4.51 miles per gallon of diesel oil. Fuel consumption per passenger was .16 gallons (3.6 miles ÷ 4.51 ÷ 5 persons). Fuel consumption for a private car traveling 3.6 miles, averaging 15 mpg is .24 gallons. If it is an economy car averaging 25 mpg, the fuel consumption is .14 gallons.

These figures should be compared to other studies. The Highway Users Federation of Washington, D.C. in Technical Study Memorandum No. 13 (July 1975) set the following costs of commuter trips (per person for a 5-mile trip) for urban areas greater than one million population in 1975:

<table>
<thead>
<tr>
<th></th>
<th>1 occupant</th>
<th>2 occupants</th>
<th>3 occupants</th>
<th>4 occupants</th>
<th>8 occupants</th>
<th>Van</th>
<th>Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobile</td>
<td>1.4 average occupant</td>
<td>$2.53</td>
<td>1.26</td>
<td>0.84</td>
<td>0.63</td>
<td>0.36</td>
<td>0.88</td>
</tr>
<tr>
<td>Van</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>Bus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The 15¢ per mile cost of running a car (mentioned above) includes cost of gas (with tax) and depreciation, insurance and maintenance. Certain public costs are not included in this figure such as revenues lost to the tax base through the construction of roads and parking facilities, and law enforcement. A San Francisco study found that money costs to the city to provide services to auto users exceeds revenues for these purposes by about 50 percent. A Portland survey found the city spending over $12 million in services to the automobile while receiving only a bit more than $8 million in state and local road revenues.**

*Current IRS allowance for the business use of an auto.

**From a paper by Russell Dawson, "Auto Subsidies and Related Costs" (in Portland Planning Bureau files).

APPENDIX D
ENERGY EFFICIENCY FOR VARIOUS TRANSIT MODES

Energy effectiveness was studied by Southern California Association of Governments in 1974 (found in Light Rail/Diesel Bus/Trolley Bus Analysis by Tri-Met). The figures are BTUs per passenger mile.

<table>
<thead>
<tr>
<th>Load factor</th>
<th>Standard Bus</th>
<th>Light Rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>2,721 BTU</td>
<td>1,476 BTU</td>
</tr>
<tr>
<td>40%</td>
<td>1,360</td>
<td>738</td>
</tr>
<tr>
<td>60%</td>
<td>907</td>
<td>492</td>
</tr>
<tr>
<td>80%</td>
<td>680</td>
<td>369</td>
</tr>
<tr>
<td>100%</td>
<td>544</td>
<td>295</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Passenger/car</th>
<th>Highway Auto</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4</td>
<td>6,800 BTU</td>
</tr>
<tr>
<td>1.6</td>
<td>5,950</td>
</tr>
<tr>
<td>2.0</td>
<td>4,760</td>
</tr>
<tr>
<td>3.0</td>
<td>3,173</td>
</tr>
<tr>
<td>4.0</td>
<td>2,380</td>
</tr>
</tbody>
</table>