U.S. Department
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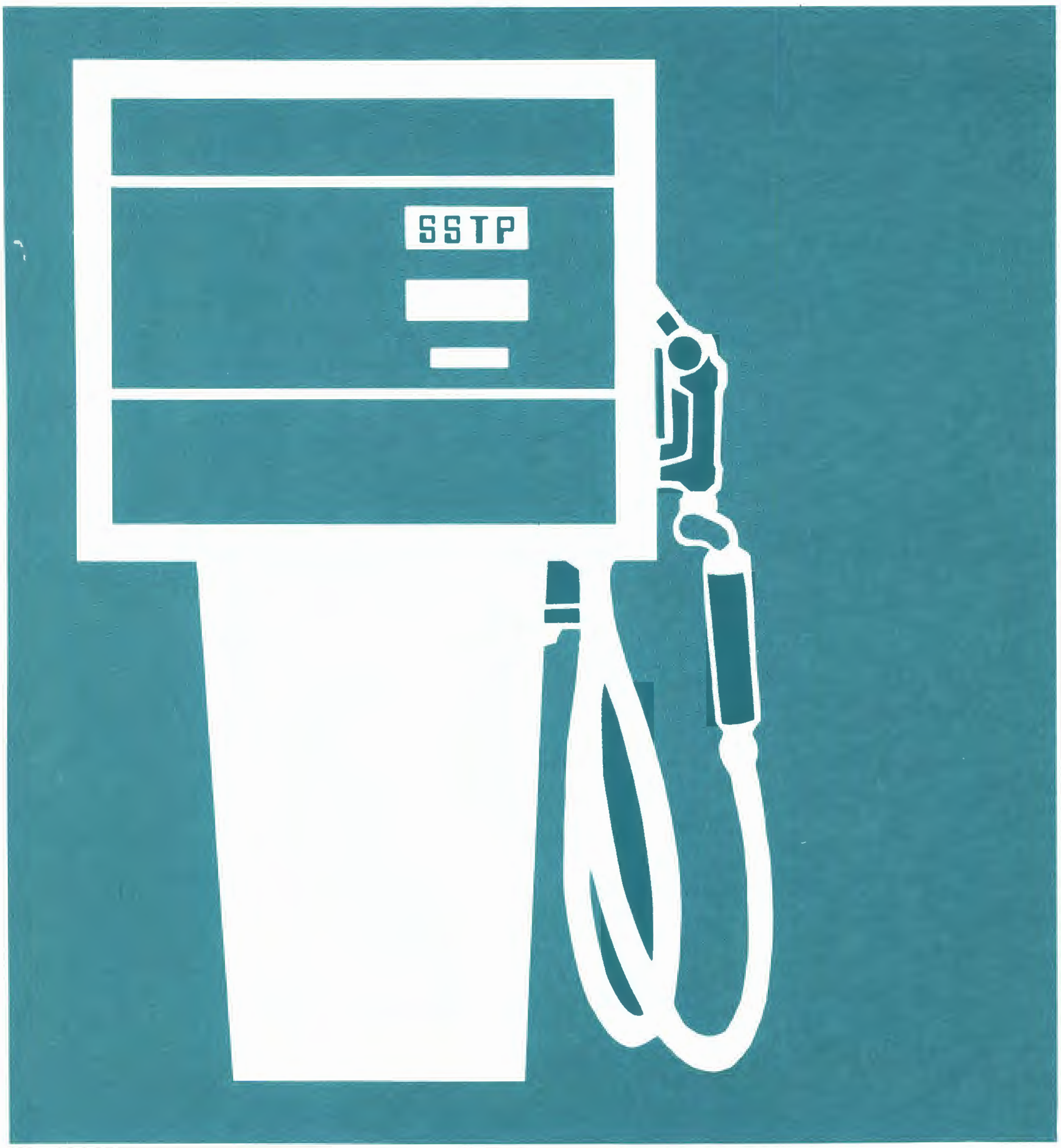
Transportation Energy Contingency Planning:

Financing Emergency Transit Services with Temporary Fare Surcharges

December 1982



Transportation Energy Contingency Planning:

Financing Emergency Transit Services With Temporary Fare Surcharges

December 1982

Prepared by

Municipality of Metropolitan Seattle

Prepared for

Office of Planning Assistance
Urban Mass Transportation Administration
Washington, D.C. 20590

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December, 1982

FOREWORD

The decontrol of petroleum early in 1981 introduced a number of new factors into planning by transit operators. Removal of price controls and supply allocation rules meant that operators would have to compete in the market place for fuel supplies with other end users and that similar market mechanisms would be likely to influence both current and potential transit users. In order to prevent changes in these market-driven factors from negatively effecting transit operators, the Urban Mass Transportation Administration (UMTA) has been and will continue to encourage energy contingency planning.

In order to assist transit operators in carrying out this important activity, UMTA is developing a number of materials providing technical assistance. Reports are being produced in a series entitled Transportation Energy Contingency Planning. Previous reports have included the folowing:

° A Guide for Transit Operators, (DOT-I-82-12);

° Transit Fuel Supplies Under Decontrol, (DOT-I-82-20);

° Taxi and School Bus Use in Dallas-Fort Worth, (DOT-I-82-38); and

° Quantifying the Need for Transit Actions, (DOT-I-83-02)

This report, Financing Emergency Transit Services with Temporary Fare Surcharges is designed to address the issue of providing the funds needed to pay for the increase in the cost of fuel in an emergency. Scenarios covering both the large increases in fuel price likely in an emergency in the absence of price controls and the need for additional fuel to support expanded service are described. We believe that transit operators concerned with this important issue in contingency planning will find this report useful.

Additional copies of this report, or others from the series, are available from our offices upon receipt of a self-addressed label, while supplies last. In addition, reports are available from the National Technical Information Service, Springfield, Virginia 22161. Please refer to UMTA-WA-09-0034-83-3 when requesting this report.

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CHAPTER 1

INTRODUCTION

Transit agencies are particularly sensitive to "energy crises." Not only do they face the same problems as consumers--higher fuel prices and difficulty in obtaining fuel--but they have the additional problem of rapidly increasing ridership as people turn to transit to solve their transportation needs. As part of their planning effort, transit agencies should consider how they are going to pay higher fuel costs and the cost of operating overload service which may be required by the additional riders.

There are several reasons why a transit agency might seek additional operating revenue during an energy crisis: (1) An inability to get more money from usual revenue sources to cover the deficit created by the energy crisis, (2) the estimated operating deficit exceeds the amount which could be covered by contingency revenue sources, or (3) a desire to pay operating expenses as they are incurred rather than at a later date. The amount of revenue needed would depend on the cause of the energy crisis and the transit agency's response to any ridership increases which occur during the crisis. For example, if rapid increases in fuel prices caused the crisis, an operating deficit would accumulate for any overload service provided and, as soon as the agency had to buy fuel at a higher than budget price, for regular service as well. However, if the crisis was due primarily to a fuel shortage and the agency had a large enough fuel reserve so that its supply was assured, the agency would only experience an unbudgeted operating deficit for any overload service it provided.

Another variable is the size of the projected operating deficit. A transit agency might initially decide to incur a small deficit rather than attempt to raise additional money from existing revenue sources, but once the deficit grew past a threshold amount, it might reverse its decision. Also, an agency might decide to recoup only a portion of the operating deficit during the crisis.

This report examines the feasibility of using a temporary fare surcharge as a source of additional operating revenue for transit agencies during an energy crisis. The characteristics of a temporary surcharge proposal, including the general advantages and disadvantages of the surcharge, are discussed in Chapter 2. Using data from the Municipality of Metropolitan Seattle, two representative scenarios were developed on the assumption that Seattle Metro would consider imposing a temporary surcharge during an energy crisis. The first scenario assumes Seattle Metro would impose a surcharge to cover the increased costs of operating its base service. The second one assumes a more severe energy crisis which would encourage Seattle Metro to provide peak overload service. Under this scenario, Seattle Metro would impose a surcharge to cover the increased costs of operating its base service and the total overload service operating costs. Background information on Seattle Metro, including their experience with previous energy crises appears in Chapter 3. The scenario details and conclusions are in Chapter 4, followed by a discussion of the limitations of a temporary fare surcharge in Chapter 5.

CHAPTER 2

TEMPORARY FARE SURCHARGE

A temporary fare surcharge imposed during an energy crisis should be easy to justify and to implement. Fare levels are always a politically sensitive issue for public transit agencies and any proposal to temporarily increase fares--which is what a surcharge would do--would be scrutinized closely. Thus, a surcharge proposal would have to explain why the transit agency needs additional revenue, how much revenue is needed, why a fare surcharge is the desired revenue source, who would pay the surcharge, how long the surcharge would be in effect, and what impact it has on operations.

2.1 Surcharge Advantages

The advantages of a temporary fare surcharge are that: (1) its imposition and removal are generally within the legal purview of the agency, (2) a collection method already exists, (3) additional revenue could be raised by merely increasing the surcharge amount, and (4) there are minimal associated administrative expenses. The existence of a fare collection system, and its control by the transit agency, lessens the amount of time between the planning and implementation phases of a temporary fare surcharge. It allows the agency to develop a contingency surcharge plan at the beginning of an energy crisis, and then to monitor fuel costs and transit ridership until the time comes to implement the surcharge plan. Once the decision was made to impose a temporary fare surcharge, a public information campaign could begin, and shortly thereafter, transit fares could increase.

2.2 Surcharge Disadvantages

The disadvantages of a temporary fare surcharge as an emergency revenue source are that: (1) higher fares may discourage people from riding the bus and cause a loss in ridership, and (2) it represents a substantial change in transit financing policy. Under normal circumstances, a loss in ridership accompanies a fare increase because some people are no longer willing (or able) to pay the higher fare to use transit service. This response of transit riders to changes in fares is known as fare elasticity. Fare elasticity numbers are negative or zero "The closer the number is to zero, the smaller the change in demand resulting from a change in price." Small (negative) numbers represent a highly <u>elastic</u> demand; large (negative) numbers represent a highly <u>elastic</u> demand.[1] Transit ridership as a whole is generally inelastic but certain market segments, such as off-peak riders, are more price elastic than others. They decrease their consumption of transit more than other market segments, such as peak hour express riders.

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1 Municipality of Metropolitan Seattle, <u>1982 Fare Increase Alternatives</u>, September 1981, p. 11.

The impact of an energy crisis on fare elasticity is unknown. It is unlikely that transit ridership would become more elastic with respect to fare increases during an energy crisis. However, there are several reasons that transit riders might be less sensitive to fare increases. New riders will be drawn to transit during an energy crisis because they find it inconvenient and increasingly difficult to obtain fuel for personal consumption. To the extent that fuel scarcity caused them to switch modes, fewer riders would be lost than with a normal fare increase. If fuel prices have increased to the point where bus travel is less expensive than their usual mode, new riders will probably be more likely to stay with transit as long as a bus surcharge does not exceed the cost of their earlier mode.

Regular riders, those who used transit prior to the energy crisis, would also respond to the proposed temporary fare increase. Some may shift to a different mode or just ride the bus less as a result of the price increase. Again, the amount of ridership loss would probably depend on the price and degree of difficulty in obtaining fuel. In summary, the relationship between ridership and fares will probably be less elastic during an energy crisis. There may be some ridership losses the first few months a surcharge is imposed during an energy crisis, but the elasticity factors are likely to decrease further if the severity of the crisis increases or its length is extended.

In addition to potential ridership losses, the other disadvantage of a temporary fare surcharge is that it represents a change in transit financing policy which may be unwelcome. Farebox revenue on the average covers 40 percent of transit operating costs, with local, state and federal dollars providing the balance. If the surcharge was priced to produce revenue only for the unbudgeted overload service, farebox revenue would pay 100 percent of the operating expense for the overload service. That pricing policy implicitly assumes that society does not have a responsibility to or may not be able to subsidize increases in transit service which accommodate riders drawn to the system because of the energy crisis. On the other hand, if the surcharge was priced to cover all or a portion of the increase in operating expenses of Base Service due to an unbudgeted increase in fuel costs, farebox revenue would pay a higher than usual percent of operating costs. However, the other financing sources would continue to partly pay for the benefits they receive from increased transit use.

2.3 Who Pays The Surcharge

As mentioned earlier, the total amount of revenue to be raised by a temporary fare surcharge is determined by the transit agency's reason for seeking additional operating revenue. The surcharge amount, however, depends upon the number of transit riders subject to the surcharge and the duration of the operating debt. The more riders paying a portion of the operating deficit, the smaller the surcharge amount paid by each transit rider. Likewise, the longer an operating debt is spread out over calendar months and years past the period the deficit was incurred, the smaller the surcharge amount.

The existing fare structure determines which rider groups could be subject to a fare surcharge. Granted, a transit agency could decide to alter its fare structure during an energy crisis to allow for greater market differentiation and pricing flexibility but it is unlikely that it would do so. Thus, regardless of who benefits from either the unbudgeted overload service or the continuation of normal levels of transit service in the face of escalating fuel costs, a transit agency with a flat fare price structure would probably have to impose the temporary fare surcharage on all its riders. On the other hand, transit agencies with more complex fare structures could consider the distribution of benefits associated with the fare surcharge in its decision on who should pay the surcharge.

During an energy crisis, a system's total transit ridership would be composed of two groups: regular riders, those individuals who used transit prior to the energy crunch, and energy-induced (E-I) riders, the people who began using transit or increased their use of transit during the energy crisis. E-I riders are expected to use all routes in the transit system, particularly those routes which are already heavily used. They are also expected to ride the bus at all times of the day, but most frequently during the weekday peak hour commute periods. Given these expected travel patterns, energy-induced riders would not be distinguishable from occasional or infrequent bus riders. Thus, in practical terms, E-I riders could not be isolated from the regular ridership and assessed a surcharge fee to cover the overload service costs they generated.

The relationship between who pays the surcharge and who benefits from energy crisis service depends on the purpose of the surcharge. If the surcharge is priced to cover the unbudgeted increase in diesel fuel costs for all transit service, and the alternative to the surcharge is a decrease in service hours, then all transit riders would be affected in proportion to their bus usage or the time of day they rode the bus (depending on the proposal to cut service hours). Since all riders benefit from continued transit service, they should all pay the surcharge. However, if the frequency and amount of service varies markedly between the peak and off-peak hours, and the fare structure permits, perhaps peak users should pay a higher surcharge amount than off-peak users.

If the surcharge is priced to cover both the operating costs of the unbudgeted peak overload service and all or a portion of the unbudgeted diesel fuel price increase for the peak riders would be expected to reap the most benefits from the overload service and uninterrupted scheduled service. However, off-peak riders would also benefit from the continued transit service. In this instance, both rider groups should pay the surcharge, with peak riders paying a higher amount per trip than off-peak riders if permitted by the fare structure.

If the surcharge is priced only to recoup the operating costs for the unbudgeted overload service, and the overload service is provided during the peak hours, then the primary beneficiaries of the overload service are the peak hour energy-induced riders who taxed system capacity and created the need for additional service. Peak hour regular riders are secondary beneficiaries of the overload service because, as a result of the additional service, they have more bus runs to choose from.

Based on the distribution of benefits from peak overload service, peak hour riders should pay the surcharge if allowed by the fare structure. However, if the overall capacity of the transit system is so full that both peak and off-peak overload service are required to accommodate the energy-induced riders, then all riders would benefit from the additional service and should pay the surcharge.

2.4 How Long Should Surcharge Last

The amount of time a temporary surcharge should be attached to transit fares, like the decision to impose a surcharge, depends on the transit agency's ability and willingness to incur a sizable operating deficit during an energy crisis. It also depends on the reason the surcharge was originally imposed and whether that reason disappears with the end of the energy crisis.

2.5 Operational Considerations

Any fare surcharge, regardless of who pays, will complicate the collection of fares and alter normal transit operations. The degree of complication for fare collection depends on a transit agency's fare structure and the number and type of fare payment options it offers. For example, if more than one fare payment option is available, such as cash fare and monthly pass, the transit agency would have to decide whether it wanted to collect the surcharge amount from each patron per bus trip or include the surcharge in the price of the monthly pass, directly collecting the surcharge only from those patrons who pay cash fares. The advantages of collecting a cash surcharge from each rider are that it: establishes a direct link between the use of transit service and surcharge payment, highlights the temporary nature of the surcharge by focusing attention on the surcharge each time it is paid, and gives the transit agency greater flexibility in the timing of surcharge implementation--the surcharge could begin or end anytime. The disadvantages of the cash only collection option are that it: increases the amount of change in fareboxes, increases passenger boarding and alighting time which may interfere with the scheduled run times, and may be contrary to a transit agency's policy of encouraging pass use.

The other surcharge collection option, including the surcharge in the price of monthly passes and collecting cash only from cash fare riders, has three major advantages. First, the benefits of each fare payment method are maintained--pass holders have the convenience of not dealing with coins, and cash fare patrons have the assurance that they are not paying for any more trips than they actually take. Second, since the surcharge is included in the pass price, additional change in the farebox is minimizied. Third, the visibility of the surcharge is minimized since pass holders do not pay it each time they ride.

The disadvantages of including the surcharge in the pass prices are that it may discourage pass purchases because of the higher price, and that patrons who bought annual passes prior to an energy crisis would not be subject to the surcharge. In addition, monthly pass pricing may result in unequal payment of the surcharge. Monthly passes are priced assuming an average number of trips per month; depending on the actual trips taken by the pass holder, they may pay more or less per trip than cash fare riders for both base fare and the surcharge.

The degree to which a temporary fare surcharge would alter transit operations depends on the collection method and the group of riders designated to pay the surcharge. In any case, drivers would have to explain the surcharge to all affected riders and answer general questions about the fare structure and collection systems.

CHAPTER 3

CASE STUDY: MUNICIPALITY OF METROPOLITAN SEATTLE

The Municipality of Metropolitan Seattle (Seattle Metro) provides transit service in King County, Washington, an area which includes the City of Seattle. It serves 1,234,000 people in a 2,128 square mile service area and carried 66 million revenue passengers in 1981. The bulk of Seattle Metro's ridership comes from Seattle and is concentrated in the weekday morning and afternoon peak periods. In 1981, Seattle Metro had an active fleet of 961 coaches, 16 percent of which are articulated buses.

Seattle Metro has a two-zone fare system with the City of Seattle as one zone and suburban King County as the other. Trips within either zone cost the same but trips across both zones cost more. Since February 1982, peak riders have paid a higher fare than off-peak riders traveling within the same fare zone. Peak fares apply to weekday trips taken between 6 a.m. - 9 a.m. and 3 p.m. - 6 p.m. and are 60 cents for a one-zone trip and 90 cents for a two-zone trip. Off-peak fares, 50 cents for a one-zone trip and 75 cents for a two-zone trip, are in effect during all other times of the weekday and throughout the weekend.

3.1 Experience With Energy Shortages

Seattle-area consumers experienced gasoline shortages in 1973-74 and 1979. "The 1974 crisis can be characterized as one with a moderately high growth in real gas price coupled with an extremely short supply of gasoline, while the 1979 crisis had a moderate shortage in supply.[1]" Impacts of the 1973 oil embargo started showing up in late fall, with gasoline lines appearing in November and becoming widespread by December. The gasoline shortage lasted through June 1974 with restricted hours continuing at some gasoline stations through September. The 1979 energy crisis began in February 1979 and lasted through August, with fuel supplies tightest in May and June.

The 1974 energy crisis caused a 15 percent increase in Seattle Metro ridership. "The 15 percent daily ridership increase amounted to a 30 percent increase in ridership during the peak hours, probably due to the more essential nature of the work trip which is primarily made during the peak hours."[2] Although the energy-induced riders used the bus at all times of the day, they only strained Metro Transit's peak hour bus capacity. In response to the increased ridership, about 3 percent more service was added during the peak hours.[3]

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1 Cy Ulberg, "Short-Term Ridership Projection Model," staff paper, Municipality of Metropolitan Seattle, June 1982, p. 7.

2 Rod Armour, "Reserve Fleet Analysis," staff paper, Municipality of Metropolitan Seattle, February 1982, p.3.

3 Municipality of Metropolitan Seattle, An Energy Crisis Contingency Plan for Metro Transit, November 1975, p. 11.

Ridership also rose during 1979, with 5 percent of the increase attributed to the fuel shortage and increased gas prices. At that time, Seattle Metro was able to absorb the additional riders without adding more service.

The primary reason for the crises--fuel shortages or fuel price increases--and their severity seem to explain the differences in ridership responses to the 1974 and 1979 crises. Although people may complain as much about rapid fuel price incrases as the decreasing availability of fuel, they are most likely to shift some of their travel to transit when faced with fuel shortages. A short-term ridership model developed by Seattle Metro has estimated that the cross-elasticity of real gas price increases and transit ridership was +0.286 during the two energy crises.[1] The model also showed that there is a clear and significant relationship between fuel shortages and ridership increases, with fuel shortages measured as waiting time at gas stations.

Although Seattle Metro provided overload service during the 1974 energy crisis, it amounted to only one percent of the total service hours, or three percent of the peak-hour service.[2] Lack of additional buses prevented Seattle Metro from providing more service to reduce the severe overload problems which existed at the height of the crisis.

As part of its energy contingency planning effort, Seattle Metro is considering a policy to maintain a reserve bus fleet which would be used to meet overload service demands during a future energy crisis. Seattle Metro has recently acquired a number of new coaches so that some of its older coaches could be used as a reserve fleet.

Based on Seattle Metro's experience with ridership increases during the 1974 energy crisis, the proposed reserve fleet would be sized at 15-20 percent of the active fleet.[3] Should the reserve fleet policy be adopted, Seattle Metro would have a much greater capability to respond to sudden ridership increases which strain the system's capacity in future energy shortages. However, Seattle Metro's annual contingency service hours budget (20,000 hours in 1982) would cover only the initial period of increased energy crisis service; continued additional service would be unbudgeted. Potentially, the system could incur a large operating deficit if the entire reserve fleet is used to provide unbudgeted overload service for a long period of time.

3.2 Energy Induced Riders

This study uses a set of assumptions about the travel behavior of transit riders during a future energy crisis. The total ridership can conceptually be divided into two groups: regular riders and energy-induced riders. Regular riders are assumed to

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1 Unpublished data from Cy Ulberg, Transit Development Division, Municipality of Metropolitan Seattle, March 1982.

2 An Energy Crisis Contingency Plan for Metro Transit, p. 11.

3 Armour, p. 4.

continue to use transit at the same time of day and with the same frequency and for the same purposes as before the energy crisis. Energy-induced (E-I) riders are those poeple who have altered their travel behavior as a result of the energy crisis and are either riding the bus for the first time or increasing the frequency of their bus use. Eighty eight percent of regular riders use the bus on weekdays[1] and it is assumed here that E-I riders will do the same. However, the two rider groups are assumed to have different time-of-day distributions with 70 percent of the total E-I ridership clustering in the peak period compared to 61 percent of the regular riders.[2] Ridership projections for this case study were based on Metro Transit's 1982 annual passenger estimate of 66.1 million passengers. An average monthly total for regular riders, 5,510,000, was calculated by dividing the annual passenger estimate by twelve. Monthly calendar and seasonal variations were ignored.

Any future energy crisis may involve both fuel scarcity and increased price. We know from experience in past crises that both of these situations will cause ridership to increase. However, the extent of future fuel shortage(s) or price increase(s) is difficult to predict, as is the duration of the "crisis" period. While an estimate of an increase in diesel fuel prices is made in this report, the uncertainty surrounding the elasticities of fuel prices in an emergency indicate that this estimate should be viewed as an asumption rather than a real forecast of increased price. Since the duration of the "energy crisis" is unknown, all calculations of cost, revenue and ridership have been done on a monthly basis. Thus, continuation of a crisis or changes in its severity can be dealt with on a relatively flexible month-to-month basis.

In order to cover a range of possible energy situations which a transit agency might encounter, scenarios representing different levels of energy induced ridership were developed. No attempt was made to attribute specific proportions of the increased ridership to higher fuel costs or decreased fuel availability. For simplicity, a one-time 78 percent increase in fuel cost is assumed to occur at the onset of the crisis. This value was chosen because it represents the average price increase of the 1974 (79%) and 1979 (76%) crises. Clearly, if fuel prices rise more than once during an energy crunch, cost and ridership numbers will change. Table 1 shows ten scenarios representing different amounts of energy induced ridership. They are based on 5 percent incremental increases of the regular rider monthly total. Each scenario contains an implicit assumption about the severity of the energy crisis; for example, a 30 percent ridership increase accompanies a more severe crisis than a 10 percent increase.

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1 Municipality of Metropolitan Seattle, <u>1982 Fare Increase Alternatives,</u> September 1981, p. 24.

2 "Fully 61 percent of all transit trips (regular riders) are taken during the three hour peaks." <u>Ibid</u>., p. 23.

TABLE 1
ENERGY SCENARIO RIDERSHIP BY TIME OF DAY

	TRANSIT TRIPS PER MONTH						AVERAGE WEEKDAY DAILY TRIPS				AVERAGE RIDER PER WEEKEND DAY
	REGULAR RIDERS ONLY						REGULAR RIDERS ONLY				
		WEEKDAY				WEEKEND					
	TOTAL	TOTAL	PEAK	MIDDAY	EVENING	TOTAL	TOTAL	PEAK	MIDDAY	EVENINGS	
	5,510,000	4,848,800	3,361,100	1,102,000	385,700	661,200	229,800	159,299	52,227	18,279	71,096
	ENERGY INDUCED RIDERS ONLY										
ENERGY SCENARIOS											
5%	275,500	242,440	192,850	35,815	13,775	33,060	11,490	9,140	1,697	652	3,555
10%	551,000	484,880	385,700	71,630	27,550	66,120	22,980	18,280	3,395	1,305	7,110
15%	826,500	727,320	578,550	107,445	41,325	99,180	34,470	27,277	5,092	1,958	10,665
20%	1,102,000	969,760	771,400	143,260	55,100	132,240	45,960	36,559	6,790	2,611	14,219
25%	1,377,500	1,212,200	964,250	179,075	68,875	165,300	57,450	45,699	8,487	3,264	17,774
30%	1,653,000	1,454,640	1,157,100	214,890	82,650	198,360	68,940	54,839	10,184	3,917	21,329
35%	1,928,500	1,697,080	1,349,950	250,705	96,425	231,420	80,430	63,978	11,882	4,570	24,884
40%	2,204,000	1,939,520	1,542,800	286,520	110,200	264,480	91,920	73,118	13,579	5,223	28,439
45%	2,479,500	2,181,960	1,735,650	322,335	123,975	297,540	103,410	82,258	15,277	5,876	31,994
50%	2,755,000	2,424,400	1,928,500	358,150	137,750	330,600	114,900	91,398	16,974	6,528	35,548

ASSUMPTIONS:

(1) Time of day distribution:

Time of day distribution	Regular Riders	Energy-Induced Riders
Peak	61%	70%
Midday	20%	13%
Evening	7%	5%
Weekend & Holiday	12%	12%

(2) Standard Month

Standard Month	
Weekdays	21.1 days
Weekend days	8.6 days
Holidays	0.7 days

3.3 Overload Service

The maximum amount of overload service that could be provided during an energy crisis would depend on the number of available reserve coaches and the desired quality of service. If Seattle Metro adopts the reserve fleet policy under consideration, it would have 201 reserve coaches in 1982. Assuming that 15 percent of the reserve fleet is set aside as spares, 171 coaches would be available to provide overload service during an energy crisis in 1982. As to desired service quality, overload service should conform with Metro Council's policy on peak hour service to the extent possible. The current policy states that: (1) the maximum allowable overload level for peak hour coaches is 130 percent of seating capacity, and (2) no one will be forced to stand for more than 20 minutes.

The majority of the energy-induced riders are expected to ride the bus in the weekday morning and afternoon three-hour peak periods. However, those riders are only expected to strain Metro's system capacity during the morning and afternoon peak one-hour periods (7:30 - 8:30 a.m., 4:30 - 5:30 p.m.). The amount of overload service required for each energy scenario can be estimated from information in Table 1 about the average 1982 daily peak ridership and the projected E-I ridership demand. The estimated requirements for weekday reserve buses and overload service hours for each scenario appear in Table 2. See Appendix A for detailed calculations. Given a maximum number of 171 reserve coaches, and assuming a systemwide peak one-hour load factor of 1.0, a 25-30 percent ridership increase could be accommodated during an energy crisis.

The overload service hours are designed to alleviate overcrowding during the weekday morning and afternoon peak one-hour periods. Their systemwide impact on Seattle Metro's system capacity is shown in Table 3. Without the proposed overload service, the average peak system ridership in a 30% energy scenario would rise from 39.01 passengers per service hour to 52.43 passengers per service hour; with the overload service, the corresponding value is 41.35.

Operating Costs For Overload Service

The cost of providing overload service was estimated on both a marginal and average cost basis because of the relationship between operating costs and length and severity of energy crisis. The marginal cost approach can be used to estimate the true cost of providing overload service for the first 3-4 months of a moderate energy crisis. It includes only those costs directly related to the provision of overload service: operator and mechanic pay, and selected equipment and supplies. The marginal cost approach assumes that reserve coaches in overload service will consume fuel and require maintenance in the same proportions as coaches in service in 1982. It also assumes that existing personnel, working overtime, can handle the increased workload associated with overload service. In a severe crisis, personnel strain would probably become limiting much sooner than 3-4 months and the average cost approach should be used.

The average cost approach represents the total average transit department cost of adding an additional hour of service to the pre-energy crisis total. It includes transit operator costs, equipment and facilities costs (labor and supplies), as well as

TABLE 2
RESERVE COACH ASSIGNMENT AND OVERLOAD SERVICE

ENERGY SCENARIO	EXTRA COACHES NEEDED PER PEAK	OVERLOAD SERVICE HOURS PER MONTH[1]
5%	0	0
10%	27	2862
15%	71	7526
20%	117	12942
25%	162	17982
27%	171	19891
30%	208	23088

1 Overload Service Hours Per Month = (# of extra buses) x (trip length) x (peak per day) x (days per month). The average trip length is assumed to increase from 2.5 hours to 2.63 hours after 80 extra coaches have been added to the peak one-hour due to traffic congestion.

TABLE 3
AVERAGE PASSENGERS PER SERVICE HOUR

	TOTAL RIDERSHIP		3 HOUR PEAK RIDERSHIP		OFF-PEAK RIDERSHIP
	WITHOUT OVERLOAD SERVICE	WITH OVERLOAD SERVICE	WITHOUT OVERLOAD SERVICE	WITH OVERLOAD SERVICE	WITHOUT OVERLOAD SERVICE
BASE SYSTEM	28.78	28.78	39.01	39.01	18.07
ENERGY SCENARIOS					
5%	30.41	30.41	41.24	41.24	18.26
10%	32.05	31.51	43.48	42.08	20.08
15%	33.68	32.24	45.72	42.05	21.09
20%	35.32	32.79	47.96	41.69	22.09
25%	36.96	33.39	50.19	41.53	23.10
30%	38.59	33.94	52.43	41.35	24.10

the cost per hour of transit operations, scheduling, marketing and planning. The average cost approach assumes a base cost equal to the 1982 total Transit Department operating expenses divided by the budgeted service hours. Use of this figure allows management flexibility in assigning drivers, paying people overtime, and hiring temporary staff. It also provides a safety margin to cover moderate increases in supply costs. In general, the total average cost per scenario is 40 percent greater than the corresponding marginal cost. The detailed calculations of marginal and average cost for overload service are given in Appendix B.

The operating deficit for the peak overload service is the difference between its operating cost and the farebox revenue from the energy-induced riders. It is assumed that without a surcharge, all E-I riders will contribute the 1982 average farebox return of 44¢ regardless of what time of day they rode the bus. Table 4 gives the monthly farebox revenue from energy induced riders (5-30 percent scenarios). The numbers in this table reflect the cost of the overload service only. They do not take into account the effect of increased fuel prices on the cost of the budgeted service. If the increased costs of higher fuel prices are not a concern (i.e., are covered by another source of funding) the additional revenue from E-I riders will cover the costs of overload service up to a certain point. It the average cost is used, the break-even point is very close to a 15 percent ridership increase. With the marginal cost method, E-I rider revenue will cover the cost of overload service for a 21 percent ridership increase.

TABLE 4
OVERLOAD SERVICE
OPERATING COSTS AND REVENUE

ENERGY SCENARIO	MONTHLY OPERATING COST OF OVERLOAD SERVICE		MONTHLY FAREBOX REVENUE FROM ENERGY-INDUCED RIDERS[1]	OPERATING DEFICIT[2]		OPERATING SURPLUS[2]	
	Marginal	Average		Marginal Cost	Average Cost	Marginal Cost	Average Cost
5%	0	0	$121,220	0	0	$121,220	$121,220
10%	$104,700	$ 143,900	$242,440	0	0	$137,740	$ 98,540
15%	$277,400	$ 380,500	$363,660	0	$ 16,840	$ 86,260	0
20%	$473,000	$ 649,300	$484,880	0	$164,420	$ 11,880	0
25%	$658,700	$ 903,500	$606,100	$ 52,600	$297,400	0	0
30%	$846,600	$1,161,000	$727,320	$119,300	$433,700	0	0

1 Assumes 44¢ Farebox return from all energy-induced riders

2 Operating Deficit/Surplus = Operating Cost - Farebox Revenue

CHAPTER 4

SEATTLE METRO CASE STUDY: TWO REPRESENTATIVE SCENARIOS

This report assumes that Seattle Metro wants to find a source of revenue to pay for the operating deficits associated with higher fuel prices and with unbudgeted overload service provided during an energy crisis. It will consider a temporary fare surcharge as that revenue source.

In this chapter, two representative scenarios are discussed in detail, one involving more costly base service only and the other involving base and overload service. The first scenario assumes an increase in the cost of Seattle Metro's base service due to a fuel price increase. It also assumes a 10 percent increase in ridership due to the energy crisis. Although crowding would result, this ridership increase could probably be handled by Metro's existing base service. A 10 percent scenario was chosen because it is the largest E-I ridership increase which could be accommodated without providing overload service. Since no overload service is provided, the only requirement for additional revenue would be to cover increased fuel costs. In this scenario, a one-time 78 percent increase in fuel cost is used (the average price increase of the 1974 and 1979 energy crises).

In the second scenario, Seattle Metro would continue to provide its existing base service, plus peak overload service during an energy crisis. It assumes a fuel price increase (78%) which would affect the cost of both base and overload service. A 30 percent ridership increase is assumed, a level which corresponds to the maximum utilization of Seattle Metro's proposed reserve fleet (171 buses).

The two scenarios will be discussed separately. Each will be divided into two sections: operating deficit and surcharge alternatives. The operating deficit sections explain the assumptions about energy induced riders, increased fuel costs, the cost of overload service in 1982 dollars, and the size of net operating deficits. The surcharge alternatives sections examine three rider group alternatives as potential surcharge payers.

In this case study, deliberately conservative revenue and cost estimates have been used to ensure that costs would be covered with a comfortable margin of safety. This has been done by using reasonable maximum numbers for cost estimates and reasonable minimum numbers for revenue estimates. For example, in calculating revenue from E-I riders, the average farebox return for <u>all riders</u> (44¢) was used; when calculating money lost because of ridership decreases caused by the surcharges, the average existing <u>base</u> fare (55.02¢) was used. This base fare excludes low fare (elderly/handicapped) riders.

4.1 More Costly Base Service

This scenario represents the limiting case for an E-I ridership increase without overload service. It may provide a useful model for transit systems which do not have the capability to provide overload service. Seattle Metro's systemwide maximum load factor for peak hour runs is currently 0.89.[1] This means that there

1 Armour, p. 4.

are now 11 percent empty seats during the critical peak hour. With 524 buses entering the Seattle CBD during this hour, and with 55 seats per bus, there are 3,170 excess seats. These seats could accommodate up to a 7.1 percent energy induced ridership increase assuming a load factor of 1.0 (everybody has a seat). (See Appendix A for details of calculations.) In the extreme case, up to a 10 percent ridership increase could probably be accommodated without adding overload service. Although this may result in some crowding, the calculated peak hour load factor of 1.1 is very similar to the peak hour loads which occurred in March, 1974.[1]

Operating Deficit

Seattle Metro currently provides 2,404,000 service hours/year (base service). On the average, 200,334 hours are provided per month at an average cost of $44/service hour. Under the conditions of our assumed crisis, a 78% increase in fuel costs adds $2.40/hour to operating costs. Increased fuel charges are then $480,800/month. It is assumed that the base service could accommodate a 10 percent increase in ridership. The increased revenue from these new riders (at 44¢/ride)is $242,400. Thus, the net operating deficit in this scenario is $238,400/month. If we assume that the entire monthly deficit must be covered and that a temporary fare surcharge is the desired revenue source, then $238,400 is the monthly revenue goal.

Fare Surcharge Alternatives

All riders would benefit from transit service continuing at existing levels in the face of escalating fuel costs. The actual surcharge needed to cover the projected operating deficit depends on who is required to pay the surcharge. In order to determine viable surcharge alternatives, an attempt was made to identify all groups of riders who could be isolated through Metro's current fare structure. The fare system differentiates between peak and off peak riders, and one and two zone trips. The following three alternatives were chosen, and for simplicity would be applied equally to one or two zone trips:

1. Apply surcharge equally to all riders

   This is probably the most equitable alternative because the increased fuel costs affect all Metro runs.

2. Apply surcharge to peak riders only

   Peak riders are less likely than others to stop using transit if their fares are increased.

3. Apply surcharge to all riders but peak riders pay a higher amount than off-peak riders

   This alternative combines the best points of the other two: all riders pay something but having peak riders pay more may help minimize ridership losses.

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1 An Energy Crisis Contingency Plan for Metro Transit, p. 23.

Each surcharge alternative was rated according to the following set of evaluation criteria: raise required revenue, minimize ridership loss, maximize surplus revenue, maintain simplicity of operations for riders and drivers, and protect low-income riders. The first two criteria, raise required revenue and minimize ridership loss, involve numerical assessments based on different surcharge amounts. (A detailed description of the procedures used to compute the revenue and ridership projections appears in Appendix C.) The amount of surplus revenue generated depends on both the size of the operating deficit and on the revenue generated. Both the fourth and fifth criteria require qualitative assessments of the effect of each fare surcharge alternative on operations and public understanding and on low-income riders.

Raise Required Revenue

The net revenue goal is $238,400 per month. To determine which alternatives satisfy the revenue objective, surcharge amounts in 5¢ increments were applied to each surcharge alternative (Table 5). If we assume that surcharge/ridership elasticity factors are not changed by the conditions of the energy crisis, then ridership losses must be figured into the net revenue gain. Using this method, the alternatives which satisfy the revenue goal are the 10¢ all rider surcharge, the 15¢ peak only surcharge and the combination 10¢/5¢ peak/off-peak surcharge. The 10¢ peak only surcharge comes very close to providing the required amount (99.6%).

If we assume that because of the energy crisis, elasticity factors are zero, then no ridership loses would occur with the surcharges. The second half of Table 5 shows monthly revenue under these conditions. If no ridership loses occur, the 10¢ peak rider surcharge comfortably covers the revenue goal, while the 5¢ all rider surcharge barely meets the goal. As before, the 10¢/5¢ combination provides sufficient revenue.

Minimize Ridership Loss

Under normal circumstances a ridership loss accompanies a fare increase. To be conservative in the estimate of potential surcharge revenue, fare elasticity factors were used in the computation of lost ridership due to different surcharge amounts for each surcharge alternative. When the pre-energy crisis factors are used, the alternatives which provide sufficient revenue result in ridership losses of 139,800 (15¢ peak only), 174,900 (10¢/5¢ combination) and 244,900 (10¢ all riders). Since the conditions of the energy crisis would cause the ridership increase, the surcharge/ridership elasticity factors would probably be decreased, but not zero. The real life situation will probably be somewhere between the two extremes shown in Table 5.

Surplus Revenue

Surplus revenue refers to the amount of money left after the revenue objectives have been met. It should be considered in the evaluation of surcharge alternatives because the more that exists, the more flexibility Metro would have in responding to unanticipated costs associated with the energy crisis or the overload service. For example, if a crisis initially involved a 10 percent E-I ridership increase, and later doubled to a 20 percent ridership increase, overload service would be required. Surplus revenue generated during the 10 percent period could help cover costs for the later overload service.

TABLE 5

MORE COSTLY BASE SERVICE
SURCHARGE ALTERNATIVES--EFFECTS ON REVENUE AND RIDERSHIP

Monthly Revenue Goal = $238,400

		ASSUMES FARE ELASTICITY FACTORS FOR SURCHARGE			ASSUMES NO FARE ELASTICITY FACTOR FOR SURCHARGE	
SURCHARGE ALTERNATIVE	SURCHARGE AMOUNT	MONTHLY REVENUE GAIN	MAXIMUM MONTHLY RIDERSHIP LOSS	MONTHLY SURPLUS REVENUE	MONTHLY REVENUE GAIN	MONTHLY SURPLUS REVENUE
All Riders	5¢	$170,500	125,000	0	$239,300	$ 900
	10¢	$328,500	249,900	$ 90,100	$466,000	$227,600
	15¢	$474,000	374,900	$235,600	$680,300	$441,900
Peak Riders Only	5¢	$121,100	46,800	0	$150,100	0
	10¢	$237,600	93,600	0	$295,500	$ 57,100
	15¢	$348,000	139,800	$109,600	$434,500	$196,100
Combination:	10¢/5¢	$292,400	174,900	$ 54,000	$384,800	$146,400
Peak/Off-Peak	15¢/10¢	$449,000	301,800	$210,600	$604,300	$365,900

Using the pre-crisis elasticity factors for ridership losses, the 15¢ all rider surcharge and the 15¢/10¢ combination surcharge generate the most surplus revenue ($210,000 and $235,000 respectively). The 15¢ peak only surcharge generates about half that amount. The projected surplus revenues are shown in Table 6. If no ridership losses occurred, the 10¢ all rider surcharge would generate a surplus of $227,600, the 10¢ peak only would generate $57,100, and the combination 10¢/5¢, $146,800.

Operations and Public Understanding

A temporary fare surcharge would complicate the collection of fares and alter normal transit operations. Regardless of surcharge alternative, it is recommended that the surcharge be collected on a trip basis from cash fare patrons, and on a monthly basis from monthly pass holders. This surcharge collection option retains the advantages of each fare payment method while minimizing the additional change in the farebox and the visibility of the surcharge to pass holders. Under this option, annual pass holders would not be subject to the temporary surcharge. In 1981, 4,600 people had Metro annual passes, of which 71 percent were employer-subsidized.[1]

The imposition of a temporary fare surcharge would have the same effect on transit operations under all the considered alternatives. Drivers would have to explain the surcharge to all affected passengers and answer general questions about the transit system put forth by energy-induced riders.

Since the additional operating costs are derived from increase fuel prices, public feeling is likely to be that all riders should share in the surcharge. A peak only surcharge may be viewed as unfair.

Protect Low-Income Riders

"According to Metro's 1977 Origin and Destination Study, low-income riders tend to ride less frequently than other riders during peak periods."[2] Assuming that the above finding holds true in a future energy crisis, the peak surcharge alternative would affect the fewest low-income riders, thus offering them the most protection from higher fares. Under the other two alternatives, all transit riders would pay a surcharge and low-income riders would not be protected from paying the temporary fare surcharge. However, low-income riders would be less affected by the combination surcharge alternative where peak riders pay 10¢ surcharge and off-peak riders a 5¢ surcharge, than by the alternative where all riders pay a 10¢ surcharge.

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1 Unpublished information from Seattle Metro's Customer Assistance Office.

2 1982 Fare Increase Alternatives Study, p. 40.

TABLE 6
MORE COSTLY BASE SERVICE
SUMMARY OF SURCHARGE ALTERNATIVES

SURCHARGE ALTERNATIVE	EVALUATION CRITERIA: MONTHLY REVENUE GAIN	MONTHLY MAXIMUM RIDERSHIP LOSS	MONTHLY SURPLUS REVENUE*	OPERATION & PUBLIC UNDERSTANDING	PROTECT LOW-INCOME RIDERS
Combination: Peak riders - 10¢ Off-peak riders - 5¢	$ 292,400	174,900	$54,000	Drivers will have to explain temporary fare surcharge and answer questions from new riders.	Some protection since low-income riders are less likely to ride during the peak.
Peak Riders Only - 10¢	$ 237,600	93,600	0	Same as above	Some protection since low-income riders are less likely to ride during the peak.
All Riders - 10¢	$ 328,500	249,900	$90,100	Same as above	No protection.

* Net revenue goal $238,400. This table represents the most conservative case where pre-crisis elasticity values are used.

Conclusion

The option which best satisfies the evaluation criteria is the combination 10¢/5¢ peak/off-peak surcharge (Table 6). This combination surcharge meets the revenue goal, provides surplus revenue, and minimizes ridership losses. It also provides some protection of low income riders while passing the increased fuel costs on to all riders.

Two other alternatives also met the revenue goal but did not meet as many of the other criteria. These were the 10¢ peak only surcharge and the 10¢ all rider surcharge. The 10¢ peak only surcharge has the lowest ridership loss among alternatives which satisfy the revenue goal. However, if pre-crisis elasticity factors hold during an energy crunch, this alternative would provide no surplus revenue. The 10¢ all rider surcharge comfortably meets the revenue goal, but would result in very high ridership losses and no protection of low income riders.

4.2 More Costly Base and Overload Service

This scenario adds the element of overload service to the previous scenario and assumes a more severe energy crisis. A 30 percent E-I ridership increase is used to model full utilization of Seattle Metro's reserve fleet. In this case, actual ridership/fare elasticity values will almost certainly be lower than pre-crisis values because an energy crisis severe enough to cause a 30 percent ridership increase will affect rider sensitivity to fare increases. However, the actual values of the energy crisis elasticity factors are unknown. Therefore, in the calculations of revenue from each surcharge alternative we used the two extreme limits for ridership loss: 1) maximum ridership loss calculated using pre-crisis elasticity factors, and 2) no ridership loss. The true situation is probably intermediate to these two extremes.

Operating Deficit

In a crisis of sufficient length and severity to require maximum utilization of the reserve fleet, there will be a heavy strain on Seattle Metro personnel. The average cost accounting method, which reflects the systemwide costs of increased service, must be used to figure the cost of overload service for this 30 percent scenario. The total monthly operating cost for overload service is $1,161,000 (Table 4). Increased fuel costs for base service add $480,800 per month for a total of $1,641,800 per month. This will be partially offset by the increased revenue brought in by the energy-induced riders ($727,300). Thus, the net operating deficit and revenue goal is $914,500.

Surcharge Alternatives

The surcharge alternatives for the overload and more costly base service are the same as for the base service alone, but the benefits in this case are different.

1) Apply surcharge only to peak riders

Peak riders directly benefit from the peak overload service because the additional service lessens the crowding on all peak buses regardless of whether someone is riding in the one hour peak or the shoulders of the peak. The majority of energy-induced riders are in this group, but a peak only surcharge ignores the fact that all runs are now more expensive.

2. Apply surcharge to all riders but peak riders pay a higher amount than off-peak riders

   This alternative reflects the difference in benefits received by peak and off-peak riders. Peak riders directly benefit from the overload service and thus pay a higher surcharge amount than off-peak riders.

3. Apply surcharge equally to all riders

   The increased fuel costs affect all runs and any peak hour service additions enhance the service quality of the entire system, thus conferring benefits to all riders. This alternative ignores the difference in benefits received by peak and off-peak riders.

The evaluation criteria are the same here as in the previous scenario: raise required revenue, minimize ridership loss, maximize surplus revenue, maintain simplicity of operations, and protect low income riders.

Raise Required Revenue

The overriding revenue objective in this evaluation procedure is $914,500, the operating deficit associated with the 30 percent E-I ridership scenario and total utilization of the reserve fleet. To determine which surcharge alternatives and amounts satisfy the revenue objective, surcharge amounts in 5¢ increments were applied to each alternative (Tables 7 and 8). Table 7 gives ridership losses assuming pre-energy crisis elasticity factors (maximum ridership losses). It appears from these calculations that the surcharge amounts required to generate sufficient revenue are the 30¢ all riders, 35¢ peak riders only and 30¢/15¢ peak/off-peak combination. However, the ridership losses associated with these high surcharges are very severe; for example, a 25¢ all rider surcharge would lose 764,000 riders.

If pre-crisis elasticity factors held, ridership losses would greatly reduce the total number of transit riders during the energy crisis. Subtraction of the ridership losses from the 30 percent energy induced ridership increase gives a new value of Net E-I ridership increase (last column, Table 7). The requirement for overload service would be reduced by these ridership losses, as would its cost. Thus, the 30 percent scenario would be converted to a smaller scenario (in some cases 20%-25%) by the high surcharge ridership losses. The revenue goal associated with a 20 percent overload service is $645,200 and with 25 percent, $778,200. Using these revenue goals with the revised E-I ridership numbers, it is apparent that the 20¢ all rider surcharge, 30¢ peak only, and 25¢/10¢ or 20¢/15¢ combination surcharge all provide sufficient income.

The other approach to this scenario, that which assumes no ridership losses, is shown in Table 8. The 20¢ all rider, the 30¢ peak only, and the 25¢/10¢ and 20¢/15¢ combination surcharges all provide sufficient revenue.

Minimize Ridership Loss

Lost ridership, calculated with pre-crisis elasticity factors, appears in Table 7. The smallest amount of ridership loss occurs when the surcharge is applied only to the peak ridership (351,300 for a 30¢ surcharge). The losses for the other alternatives which meet the revenue goal are: 20¢ rider surcharge, 612,000; a 20¢/15¢

TABLE 7

MORE COSTLY BASE AND OVERLOAD SERVICE
SURCHARGE ALTERNATIVES--REVENUE AND RIDERSHIP EFFECTS
ASSUMING FARE ELASTICITY FACTORS
Monthly Revenue Goal = $914,500

SURCHARGE ALTERNATIVE	SURCHARGE AMOUNT	MONTHLY REVENUE GAIN	MAXIMUM MONTHLY RIDERSHIP LOSS	MONTHLY SURPLUS REVENUE	NET E-I RIDERSHIP INCREASE[1]
All Riders	5¢	$ 208,800	153,000	0	27.2%
	10¢	$ 402,400	306,100	0	24.5%
	15¢	$ 580,600	459,100	0	21.7%
	20¢*	$ 743,400	612,100	0	18.9%
	25¢*	$ 889,400	763,500	0	16.1%
	30¢	$ 1,021,900	916,500	$ 2,000	13.4%
Peak Riders Only	5¢	$ 151,900	58,700	0	28.5%
	10¢	$ 297,900	117,300	0	27.0%
	15¢	$ 436,200	175,300	0	25.5%
	20¢	$ 570,500	234,000	0	23.9%
	25¢	$ 699,000	292,600	0	22.4%
	30¢*	$ 821,500	351,300	0	20.9%
	35¢	$ 938,200	410,000	$23,700	19.4%
Combination: Peak/Off-Peak	10¢/5¢	$ 362,400	213,100	0	26.1%
	15¢/10¢	$ 545,500	366,800	0	23.3%
	20¢/15¢*	$ 734,800	520,500	0	20.6%
	25¢/15¢*	$ 863,300	579,100	0	19.5%
	30¢/15¢	$ 985,800	637,800	$71,300	18.4%
	25¢/20¢*	$ 899,100	674,900	0	17.8%
	25¢/10¢*	$ 808,300	484,100	0	21.2%

[1] Based on a 30% Energy-Induced Ridership increase of 1,653,000 (All Riders) or 1,157,100 (Peak Riders).

* Surcharges which meet revised revenue goals for less overload service.

TABLE 8
MORE COSTLY BASE AND OVERLOAD SERVICE
SURCHARGE ALTERNATIVES--REVENUE EFFECTS ASSUMING
NO FARE ELASTICITY FACTOR

Monthly Revenue Goal=$914,500

SURCHARGE ALTERNATIVE	SURCHARGE AMOUNT	MONTHLY REVENUE GAIN	MONTHLY SURPLUS REVENUE
All Riders	5¢	$ 293,000	0
	10¢	$ 570,800	0
	15¢	$ 833,200	0
	20¢	$1,080,200	$165,700
	25¢	$1,309,500	$395,000
	30¢	$1,526,100	$611,600
Peak Riders Only	5¢	$ 188,200	0
	10¢	$ 370,500	0
	15¢	$ 544,700	0
	20¢	$ 715,300	0
	25¢	$ 880,100	0
	30¢	$1,038,900	$124,400
	35¢	$1,191,900	$277,400
Combination: Peak/Off-Peak	10¢/5¢	$ 475,700	0
	15¢/10¢	$ 735,400	0
	20¢/15¢	$1,001,300	$ 86,800
	25¢/15¢	$1,166,100	$251,600
	30¢/15¢	$1,324,900	$410,400
	25¢/20¢	$1,242,600	$328,100
	25¢/10¢	$1,070,800	$156,300

combination surcharge, 520,500; and for a 25¢/10¢ surcharge, 484,100. The actual ridership increase would undoubtedly be less than the numbers in Table 7.

Maximize Surplus Revenue

Since the energy crisis elasticity factors and surcharge-caused ridership losses are unknown, surplus revenue can only be expressed as ranges: 20¢ all rider surcharge, $98,000-$166,000; 30¢ peak only surcharge, $124,000-$175,000; 20¢/15¢ combination surcharge, $87,000-$89,000 and 25¢/10¢ combination surcharge, $131,000-$156,000.

Operations and public understanding

As in the base service only scenario, it is recommended that the surcharge be collected on a trip basis from cash fare patrons, and on a monthly basis from monthly pass holders. This surcharge collection option retains the advantages of each fare payment method while minimizing the additional change in the farebox and the visibility of the surcharge to pass holders. Under this option, annual pass holders would not be subject to the temporary surcharge. Since the purpose of the surcharge is twofold, to cover both more costly base service and peak overload service, public perception of fairness would probably be greatest with a combination peak/off-peak surcharge.

Protect Low Income Riders

As discussed in the previous scenario, low income riders are less likely than others to ride during the peak periods. Thus, a peak only surcharge offers the most protection of low income riders. A combination peak/off-peak surcharge offers some protection, while an all rider surcharge offers none.

Conclusion

Given the purpose of the temporary fare surcharge, the best alternative is the 25¢/10¢ combination surcharge (Table 9). In addition to generating enough revenue to cover the operating deficit associated with increased fuel prices and overload service, it provides the most equitable distribution of energy crisis costs. All riders pay for the increased fuel costs and peak riders pay more for peak hour overload service. The peak only 30¢ surcharge generates a similar amount of revenue and loses slightly less riders, but it is a very large increase and would probably be viewed by peak riders as unfair. The 25¢/10¢ combination surcharge generates more revenue and causes less ridership loss than the 20¢/15¢ combination surcharge. An all rider surcharge (20¢) causes the largest ridership losses, provides no protection for low income riders, and would not contribute to public understanding of Metro's response to the energy crisis.

4.3 Overview

In this report we have used data from Seattle Metro to develop a case study of a temporary fare surcharge as an energy crisis financing mechanism. The case study was divided into two scenarios, representing moderate and severe crises. In the first scenario, More Costly Base and Overload Service, we assume that a 10 percent energy induced ridership increase could be handled without adding overload service. A 10¢ peak/5¢ off-peak temporary fare surcharge is recommended to offset the additional operating costs due to the energy crisis. It provides sufficient revenue to cover the costs associated with a 78 percent increase in fuel prices, distributes the

TABLE 9
MORE COSTLY BASE SERVICE
SUMMARY OF SURCHARGE ALTERNATIVES

	EVALUATION CRITERIA				
SURCHARGE ALTERNATIVE	MONTHLY REVENUE GAIN	MONTHLY MAXIMUM RIDERSHIP LOSS	MONTHLY SURPLUS REVENUE*	OPERATION & PUBLIC UNDERSTANDING	PROTECT LOW-INCOME RIDERS
Combination: Peak - 20¢ Off-peak - 15¢	$734,800-$1,001,300	520,500	$87,000-$89,000	Drivers will have to explain temporary fare surcharge and answer questions from new riders.	Some protection since low-income riders are less likely to ride during the peak.
**Combination: Peak - 25¢ Off-peak - 10¢	$808,300-$1,070,800	484,100	$131,200-$156,300	Same as above	Same as above
Peak Riders Only-30¢	$821,500-$1,038,900	351,300	$124,000-$175,000	Same as above	Some protection since low-income riders are less likely to ride during the peak.
All Riders-20¢	$743,400-$1,080,200	612,100	$98,000-$166,000	Same as above	No protection

* Revenue numbers are given as a range because of the range of possible ridership losses.

** Recommended surcharge.

increased costs to all riders while maintaining the peak off-peak fare differential, and offers some protection to low-income riders.

The second scenario, More Costly Base and Overload Service, is somewhat more complicated. The costs associated with 30 percent overload service and increased fuel prices are so high that large surcharges are required to completely cover costs. These large surcharges would cause high ridership losses if pre-crisis elasticity factors hold in a crisis situation. However, a crisis severe enough to cause a 30 percent ridership increase probably would decrease elasticity factors. Using the pre-crisis factors to calculate maximum ridership losses as one extreme and zero ridership losses as the other, the limits of this scenario were covered. A 25¢/10¢ peak/off-peak temporary fare surcharge is recommended. Thus, the best alternatives in each scenario are the same, a combination peak/ off-peak surcharge, with a more severe crisis dictating a larger combination.

CHAPTER 5

CONCLUSIONS

This study was designed to determine the feasibility of the temporary surcharge as an emergency financing mechanism. Assumptions were made about fuel availability and fuel price activity based on Seattle Metro's past experience, not extensive modelling efforts.

The Seattle Metro case study demonstrates that a temporary surcharge could generate monthly revenue during an energy crisis to meet unbudgeted operating costs. Although a surcharge would probably slow the energy-induced ridership increase due to higher fares, it would cause few operational problems.

Transit ridership increases which occur in response to a growing energy crisis would most likely be spread out over a period of months. Thus, a scenario with a single ridership increase, such as the Seattle Metro case study, would represent only a short crisis or a segment of a longer crisis.

The timing of a temporary surcharge depends on projections of the duration and severity of the energy crisis, and of public response to the proposal. A transit agency would want to avoid imposing the surcharge too early in the crisis just in case it has overestimated the need for overload service or the impact of increased diesel fuel cost on transit operations. It would also want to avoid retaining the surcharge past the publicly perceived end of the crisis to dilute public criticism of the surcharge as a permanent fare increase. The political sensitivity of a temporary surcharge on transit fares should not be underestimated.

APPENDIX A
METHOD FOR ESTIMATING OVERLOAD SERVICE

On a systemwide basis, it is assumed that the increased ridership during an energy crisis would exceed Metro's capacity only during the weekday peak one-hour period: 7:30 a.m. - 8:30 a.m. and 4:30 p.m. - 5:30 p.m. Thus, any overload service provided with reserve coaches would be scheduled for the peak one-hour period. To estimate the overload service by scenario, the following information is needed about the peak one-hour periods: the seating capacity prior to the energy crisis, including excess seats, the extra seating capacity required by energy-induced riders, the number of reserve coaches available, and the average overload trip length.

<u>Excess Seating Capacity in Pre-Energy Crisis System</u>

Assume (1) Systemwide maximum peak one-hour load factor of 0.89, prior to the energy crisis.[1]

(2) Systemwide maximum peak one-hour load factor of 1.0 during the energy crisis.

(3) 55 average seats per bus.[2]

(4) 524 buses going through the Seattle CBD during each peak one-hour period.[3]

$$\text{Excess Seating Capacity} = \left(\begin{array}{l}\text{Energy Crisis Peak One}\\ \text{Hour Load Factor}\end{array}\right) - \left(\begin{array}{l}\text{Pre-Energy Crisis}\\ \text{Peak One-Hour Load Factor}\end{array}\right)$$

$$= (1.0) - (0.89)$$

= .11 or 11 percent empty seats

$$\text{Excess Seats} = \left(\begin{array}{l}\text{Excess Seating}\\ \text{Capacity}\end{array}\right) \times \left(\begin{array}{l}\text{Average Seats}\\ \text{Per Bus}\end{array}\right) \times \left(\begin{array}{l}\text{Number of Buses}\\ \text{Going Through the}\\ \text{Seattle CBD}\end{array}\right)$$

$$= (.11) \times (55) \times (524)$$

= 3170 empty seats in the morning peak one-hour and in the afternoon peak one-hour.

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1 Armour, p. 4. This load factor is for inbound buses during the morning peak one (1) hour period entering the Seattle CBD. Because load factors are highest for the CBD, use of this load factor as systemwide average may underestimate the amount of excess system capacity.

2 This average reflects Seattle Metro's fleet of articulated and regular sized buses.

3 Calculated from Seattle Metro Transit Schedule Pages, Weekday, April 2, 1982 (microfiche) and Seattle Metro Transit In & Out Pages, Weekday, April 2, 1982 (microfiche) with data from the February 1982 Sign-Up. Of the 840 buses on the road during the peak one-hour, 83 percent, or 524 buses go through the CBD.

Energy Scenario Seating Capacity Requirements

Assume (1) Peak riders in the pre-energy crisis system are distributed as follows:

Peak one hour (7:30 a.m.-8:30 a.m.; 4:30 p.m.-5:30 p.m.)	52%
7 a.m.-7:30 a.m.; 8:30 a.m. - 9:00 a.m.; 4 p.m.-4:30 p.m., 5:30 p.m.-6:00 p.m.	28%
6:00 a.m.-7:00 a.m.; 3:00 p.m.-4:00 p.m.	20%
3 Hour Peak (6:00 a.m. - 9:00 a.m.; 3:00 p.m. - 6:00 p.m.)	100%

(2) 5 percent of the energy-induced peak ridership will shift its travel from the peak one-hour to the other two hours of peak in proportion to the above time-of-day ridership distribution.

(3) One seat for each peak one-hour passenger.

Create Energy Induced Peak Hour Ridership Distribution

Shift 5 percent of the one-hour peak to the shoulders of the total three-hour peak (.05 x 52% = 2.6%).

Thus 2.6 percent of the peak riders will be taken from the peak one-hour and distributed proportionately:

	Unadjusted Distribution	Adjustment	New Distribution
Peak 1 Hour	52%	-2.6%	49.4%
7:00 a.m.-7:30 a.m.; 8:30 a.m.-9:00 a.m., etc.	28%	+1.5%	29.5%
6:00 a.m.-7:00 a.m., etc.	20%	+1.1%	21.1%
3 Hour Peak	100%	0	100.0%

Keeping in mind that energy-induced riders will strain the system only during the one-hour peaks, and that there are two peaks per day, the Energy Scenario Seating Capacity Requirement is calculated as follows:

$$\frac{\text{(Daily E-I Peak Trips)}}{\text{(2 Peak Periods Per Day)}} \times \left(\begin{array}{l}\text{Percent of Peak E-I}\\ \text{Riders in Peak One-Hour}\end{array}\right)$$

Extra Seats Needed for E-I Riders

For each energy scenario, subtract the required seating capacity from the excess number of seats in the peak one-hour pre-energy crisis system (3,170 seats) to calculate the extra seats needed for the E-I peak one-hour ridership.

Reserve Buses Needed for E-I Riders

Assume (1) 50 seats per reserve bus
(2) 171 available reserve buses

For each energy scenario, divide the number of extra seats needed for E-I Riders by 50 seats to calculate the number of reserve buses necessary to provide, on a systemwide basis, all E-I peak one-hour riders with a seat. Determine which energy scenarios could be accommodated by the available reserve fleet. Disregard all other scenarios for the remainder of the study.

Overload Service

Assume (1) All new service is added to the morning and afternoon peak one-hour periods.

(2) Each reserve coach is used as a tripper (only to fill in peak service).

(3) Average tripper length of 2.5 hours for 1 - 80 coaches added to the peak one-hour, and 2.62 hours for 81 or more coaches. The difference in trip length is due to the impact of traffic congestion or the amount of time buses would spend in the CBD.[1]

(4) The standard month consists of:

21.1 Weekdays
9.3 Weekend days and holidays

The Reserve Bus Estimate For Each Energy Scenario is the following:

$$\text{Overload Service Hours per Month} = \begin{pmatrix}\text{Number of}\\ \text{Reserve Buses}\\ \text{Required}\end{pmatrix} \times \begin{pmatrix}\text{Average}\\ \text{Trip Length}\\ \text{Hours}\end{pmatrix} \times \begin{pmatrix}\text{2 peaks}\\ \text{Per Day}\end{pmatrix} \times \begin{pmatrix}\text{21.1 Weekdays}\\ \text{Per Month}\end{pmatrix}$$

Table A-1 gives the monthly overload service hours for each energy scenario.

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1 Conversation with Mr. Paul Donnelly, Seattle Metro Transit Scheduling Supervisor, May 1982.

TABLE A-1

MONTHLY OVERLOAD SERVICE HOURS BY ENERGY SCENARIO

Energy Scenario	Daily E-I Peak Riders ÷ 2	E-I Required Seats Capacity[1]	E-I Required Seats/3170 Excess Seats[2]	Extra Buses Needed[3]	Monthly Overload Service Hours[4]
5%	4570	2258	-912	0	0
10%	9140	4515	1345	27	2862
15%	13639	6737	3567	71	7526
20%	18280	9030	5860	117	12942
25%	22850	11288	8118	162	17982
30%	27420	13545	10375	208	23088
35%	31989	15802	12632	253	
40%	36559	18060	14890	298	
45%	41129	20318	17148	343	
50%	45699	22576	19406	388	

1 E-I Peak Required Seats = (Daily E-I Peak Riders ÷ 2) ÷ 50 seats per reserve bus.

2 3170 Excess Seats = Amount of excess seats in pre-energy crisis transit system assuming a peak one-hour load factor of 1.0

3 Extra Buses Needed = (E-I Required Seats - 3170 Excess Seats) ÷ 50 Seats per Reserve Bus

4 Monthly Overload Service Hours = (Extra Buses Needed) x 106 Service Hours per Month (if # of extra buses LE 80)
or
111 Service Hours per Month (if # of extra buses GT 80)

APPENDIX B
METHODS FOR CALCULATING OVERLOAD SERVICE OPERATING COSTS

A marginal cost approach can be used to calculate overload service operating costs with a moderate energy crisis of relatively short duration. It includes only the actual operating costs of additional service hours and the cost of one street supervisor per 25 additional trippers (Table B-1). Driver assignments would be made according to current Seattle Metro policy. Seattle Metro has both part-time and full-time transit operators. In the event of an energy crunch, all overload service would be assigned as trippers which would go out as extra board assignments. We can assume that extra board operators (full-time operators capable of driving many routes) would have the first choice of assignments. They would be paid at an overtime rate. Once extra board operators had worked as many overload hours as they wanted, part-time operators would be able to choose extra-board assignments. Paid at their regular rate, they would be allowed to work a total of two trips per day. It is assumed that part-time drivers would eventually provide 75 percent of the overload service and that few drivers would have to be hired on a temporary basis. The marginal approach assumes there are enough qualified drivers to cover the overload trippers without incuring additional training and qualification costs.

The average cost approach is required with a severe energy crisis, or a moderate one lasting more than 3-4 months. This includes operator, equipment, supply and facilities costs as well as transit operations, scheduling, marketing and planning. This base service hour cost is figured as Seattle Metro's total operating expenses divided by the budgeted service hours.

In addition to the base service hour cost, the average approach assumes that 75 percent of the weekday trippers would be operated by existing part-time drivers and that all of those drivers would have to go through a qualifying procedure before they could operate the overload trippers. Drivers would be paid at their regular rate for the qualification period. It assumes that all part-time operators who have overload asignments would work more than 90 hours a month for five consecutive months, thus requiring Seattle Metro to pay them pension benefits. This approach also assumes that one street supervisor would be hired for each additional 25 trippers.

All of the above costs can be expressed per service hour. Other costs that Metro might incur, but are difficult to estimate in advance, are new operator training costs and unemployment insurance payments. The total cost of training a full-time operator is $2,800 compared to a part-time training cost of $1,700. If Metro laid off employees after the energy crisis had passed, it would have to reimburse the State Unemployment Insurance Fund for benefits paid to former employees who quality for unemployment benefits. The weekly benefit an unemployed person can receive currently ranges from $45 to $165 and is calculated from an employee's wages during the first four of the last five completed calendar quarters. Benefits are now available for a maximum of 52 weeks with Seattle Metro responsible for paying 100 percent of the first 26 weeks of benefits, 50 percent of the next 13 weeks, and 100 percent of the last 13 weeks of benefits. Thus the maximum amount of unemployment benefits Metro would pay for one laid-off employee is $7,417.

The average costs of peak overload service by scenario is shown in Table B-1.

TABLE B-1
MONTHLY COST OF ENERGY-INDUCED PEAK OVERLOAD SERVICE

RIDERSHIP INCREASE SCENARIOS	TRIPPERS PER WEEKDAY	EXTRA OVERLOAD SERVICE HRS PER MONTH	STREET(1) SUPT. COST PER MONTH	PART-TIME(2) OPERATORS QUALIFYING COST/MONTH	PART-TIME(3) PENSION COST PER MONTH	MARGINAL(4) OPERATOR & EQUIP/FAC COSTS/MONTH	AVERAGE(5) TRANSIT DEPARTMENT COSTS/MONTH	(1)+(4) TOTAL MARGINAL COSTS/MO.	(1)+(2)+(3)+(5) TOTAL AVERAGE COSTS/MO.
5%	0	0	0	0	0	0	0	0	0
10%	54	2,862	$ 6,168	$1,304	$ 3,595	$ 98,500	$ 132,800	$104,700	$ 143,900
15%	142	7,526	$18,504	$3,403	$ 9,383	$258,900	$ 349,200	$277,400	$ 380,500
20%	234	12,942	$27,756	$5,597	$15,433	$445,200	$ 600,500	$473,000	$ 649,300
25%	324	17,982	$40,092	$7,727	$21,309	$618,600	$ 834,400	$658,700	$ 903,500
30%	416	23,088	$52,428	$9,923	$27,359	$794,200	$1,071,300	$846,600	$1,161,000

(1) One street supervisor for every additional 25 trippers per weekday. Monthly cost = $3,084

(2) Assume 75% of the number of trippers per weekday will be operated by existing part-time (PT) transit operators and that all of those PT operators will have to go through a training and qualifying procedure before they can operate the overload trippers. One-time average qualification costs per tripper = $31.80.

(3) Assume that all PT operators working two trippers per day will exceed 90 hours of work a month for five consecutive months, thus Seatle Metro will have to match 6.5% of their hourly wages as pension benefit. Given an average hourly wage of $12.15, the pension benefit equals $0.79 per hour assuming an average of 111 hours per month (2.62 hrs/tripper x 2 trippers/day x 21.1 days/month). Thus, the average monthly pension benefit per part-time operator equals $87.69.

(4) $34.40 per overload service hour.

(5) $46.40 per overload service hour.

APPENDIX C
METHOD FOR COMPUTING REVENUE GAIN AND RIDERSHIP LOSS

To compute the revenue gain and ridership loss associated with a temporary surcharge, information is needed about the rider groups subject to the temporary fare surcharge, the average existing fare, the average percent fare increase, the elasticity factors and the proposed surcharge amounts. The proposed groups of riders subject to the temporary fare surcharge are: all riders, peak riders only, and all riders split into peak and off-peak riders with each subgroup paying a different surcharge amount. The surcharge amount varies from 5¢ to 35¢.

Riders Subject to Surcharge

Before either ridership loss or revenue gain can be calculated, an estimate of the number of riders per scenario who would be subject to the surcharge must be made. Assuming that 100 percent of the energy induced riders and 79 percent of the average monthly regular ridership would be subject to the fare surcharge under each scenario, the total number of riders can be calculated for each surcharge alternative by adding the monthly estimates of E-I riders and regular riders for three categories: total riders, weekday peak hour riders and off-peak riders. The 21 percent of the average monthly regular ridership who would not pay the fare surcharge represents those rider groups excluded from Metro's 1982 fare increase: namely, elderly and handicapped riders, ride-free zone riders and other riders.

Ridership Loss

Ridership loss is calculated by multiplying the monthly ridership total for the rider group subject to the surcharge by the appropriate fare elasticity factor and the percent the fare is being increased by. The fare elasticity factors used by Seattle Metro to evaluate 1982 fare increase alternatives are assumed to apply to the evaluation of fare surcharge alternatives: -.28 for all riders, .19 for peak riders (3-hour) and -.37 for off-peak riders.[1] The percent fare increase due to the surcharge depends on the average existing fare for each rider group alternative and the proposed surcharge amounts. Average existing fares were calculated using the estimated 1982 systemwide fare of 44 cents. The ridership loss associated with each surcharge alternative by three energy scenarios appears in Table C-1.

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1 The elasticity factor for all riders comes from an article by Lago, Mayworm and McEnroe, "Transit Ridership Responsiveness and Fare Charges", Traffic Quarterly, Vol. 35, No. 1, January 1981, pp. 117-142. The peak and off-peak factors are derived from the source using the following equations:

3-Hour Peak $-.28 = x \left(\text{\% of ridership in peak}\right) + 2x\ (\text{\% of ridership in off-peak})$

Off-Peak $-.28 = x \left(\text{\% of ridership in off-peak}\right) + 2x\ (\text{\% of ridership in off-peak})$

Net Revenue Gain

"The revenue gain calculation is a four step process. Lost revenue, retained ridership and gross revenue must be calculated before the final total is reached. Lost revenue is equal to ridership loss multiplied by the average existing fare."[1] Retained ridership that would be subject to a temporary fare surcharge is equal to the original group ridership estimate minus the lost ridership. "The gross revenue gain is generated by multiplying the retained ridership by the existing fare and by the percent of the fare increase. Finally, the net revenue gain is the result of subtracting the lost revenue from the gross revenue gain."[2]

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1 1982 Fare Increase Alternatives, p. A-1.

2 Ibid.

TABLE C-1
RIDERSHIP LOSS BY SURCHARGE ALTERNATIVE AND ENERGY SCENARIO

SURCHARGE ALTERNATIVE	AVERAGE EXISTING FARE	SURCHARGE AMOUNT	PERCENT FARE INCREASE	RIDERSHIP LOSS ENERGY SCENARIOS		
				20%	25%	30%
All Riders	55.02¢	5¢	9.1%	139,000	146,000	153,000
All Riders	55.02¢	10¢	18.1%	276,500	290,400	304,400
Peak Riders Only	61.89¢	5¢	8.1%	52,700	55,700	58,700
Peak Riders Only	61.89¢	10¢	16.2%	105,500	111,400	117,400
Peak Riders Only	61.89¢	15¢	24.2%	157,600	166,400	175,300
Combination: 10¢/5¢				194,100	203,600	213,200
Peak Riders	61.89¢	10¢	16.2%	105,500	111,400	117,400
Off-Peak Riders	42.49¢	5¢	11.8%	88,600	92,200	95,800

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