The City of Edmonton

TRANSIT FARES AND SUBSIDIES

Transit Strategy Guiding Perspectives Report

Sustainable Development;Transportation Strategies
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TABLE OF CONTENTS

1. Background & Theory

1.1. Introduction

At first glance, it may seem odd that transit fares could be complex enough to warrant detailed technical studies. The fare appears as just a single price (e.g. $3.25) intended to generate money needed to operate the transit system. However, upon closer examination fare policy is surprisingly complicated with difficult choices that must be made. This complexity is the result of numerous discounts being offered combined with different options for collecting and enforcing fare payment. Fare rates, discounts, collection and enforcement are, in turn, the result of tradeoffs between contradicting objectives, such as revenue vs community benefits and equitable fares vs simple fares.

1.2. Important Concepts

1.2.1. Common Terms

Several important terms that are used throughout this paper are shown below:

- **Agency:** Each transit system is operated and managed by some form of "Transit Agency", which is most often some form of government institution. Transit agencies are most often chartered by municipal governments, but it is not uncommon for agencies to be given authority by a regional, provincial, or federal government. Agencies can also be private corporations, although they are seldom entirely separated from the government.
- **Cost & Price:** In order to distinguish between expenditures by the agency and those by individual passengers, the term "Cost" will be used when referring to expenditures by the agency related to providing the service while "Price" will be the price passengers pay. The only exception to this convention will be the term "Generalized Cost".
- **Economies of Scale**: Unlike most goods and services, the cost to provide transit service changes very little as use increases. As a result, the marginal cost to transport each passenger tends to decrease as ridership increases. This effect, called "Economies of Scale" is contrary to most goods and services which see increasing marginal costs due to the effect of "diminishing marginal returns". [1]
- **Fare Media:** All transit agencies allow for multiple ways of purchasing fares, the most common being "**Paper tickets**" which are purchased prior to boarding and "**Cash**" which is given for payment at the on the transit vehicle boarding. Another common method is **"period pass**" which can be used any number of times but is only valid for a specified duration of time (typically a day, month or year). "**Stored Value Farecard**" is a plastic card or ticket that has a specific value which is reduced each time it is used. Such media can be linked to an account tracked by a computer or the value may be stored on the media itself and can often be recharged or refilled.
- **Fare structures:** Transit agencies offer a variety of fare products, (such as cash fare, bulk purchases and period passes) as well as discounts to various groups (such as seniors, small children, students and persons with disabilities.) As such, fares should not be thought of as a single value, but as a "structure" that includes all fare purchase options.
- **Recovery:** One useful measure of the level of subsidy is in terms of the ratio of Revenue/Total Cost, which is referred to as either the "Recovery" or "R/C" and often presented as a percentage. For example a recovery or 45% indicates that 45% of the funding required to operate the system is generated through revenue and 55% is provided by subsidies.

- **Targeted & Untargeted:** The term "targeted" is used throughout this paper to indicate a policy, goal or discount that is limited to a small subset of the community (such as discounts for seniors or students) or to a specific service (such as free park and ride shuttles to football games). Untargeted items are thus available to any transit user and any area (such as discounts for monthly passes or below cost fares intended to increase ridership).

1.2.2. Social Equity

Public transit is usually funded by a combination of user fees and public funding, which is typically considered to be equitable because it provides a benefit to both the users and the entire community. The benefit to those who use it is safe, affordable transportation that does not require passengers to own, drive or park a vehicle. The benefits to general public include reduced congestion, cleaner air and supporting the social, economic, and environmental health of the community. [2] However, the degree to which the service provides each type of benefit is unclear, and so leaders must rely on community values as much as technical information when deciding the appropriate level of public funding to use [3].

If the benefit to the community is considered much higher than the benefit to the users, a large portion of the funding may be provided through subsidy. However it is important to realize that heavy dependence on subsidy can result in financial crisis if funding levels are reduced substantially [3]. Fare Free Public Transportation (FFPT) takes this idea to the extreme by totally eliminating fares. As discussed in section 2.4, FFPT systems are usually only practical for small communities, or those dominated by a resort or University which are able to accommodate the related financial challenges, security problems and dramatic increase in ridership. [4]

Where public funding is unavailable or where the value to users is considered predominant, transit service may be funded almost entirely through fares. Due to economies of scale (discussed in section 1.3), routes with greater ridership are usually much more profitable than those with lower ridership. [3] However, community goals such as social equity and poverty elimination usually require transit service to areas with low demand and during time periods with lower ridership. [5] In order to remain viable without subsidies, such systems must reduce service with low ridership and raise fares, which limit their ability to provide community benefits.

1.2.3. Transit Demand

Transit demand is the result of many factors including service quality, the area being served and the preferences of those in the service are. The factors with the most impact have been studied and modeled to estimate how changes in service or fares are likely to change demand. A common convention is to present these as "elasticities" that indicate the change in demand from a 1% change in that factor, as shown in Table 1 below. These values are based on averages from a number of Canadian municipalities and while they are adequate for understanding general relationships, each subpopulation will have elasticities that reflect their unique characteristics. [3] For example, fare price has an elasticity of -0.32 which means for every 1% increase in fares an agency should expect demand to decrease by 0.32%. [6] Travel time, waiting time and fares are considered the most important factors that transit agencies have direct control over. Other factors such as comfort and safety are difficult to quantify or model. The elasticity of travel time is nearly twice fare price and so reducing travel time will typically have approximately twice the impact on demand as reducing fare rates [6].

"Generalized cost" is a related concept that is useful for modeling competing transportation modes (personal vehicle, transit, bicycle, etc.). For any given trip, each mode has a "cost" that reflects monetary costs as well as travel time and potentially other characteristics. Demand for each mode will then depend on its relative cost with the lowest cost choice being the most popular. [7]

TABLE 1: EXAMPLES OF TRANSIT RIDERSHIP ELASTICITY

Factor	Elasticity	Description
Regional employment	0.25	1% increase in regional employment is likely to increase ridership by 0.25%
Central city population	0.61	1% increase in central city population is likely to increase ridership by 0.61%
Fare price	(0.32)	1% increase in fares is likely to decrease ridership by 0.32%
Wait time	(0.30)	1% increase in time customers wait for a bus is likely to decrease ridership by 0.30%
Travel time*	(0.60)	1% increase in travel time is likely to decrease ridership by 0.60%

* Factors such as discomfort and risk affect Travel Time. For example, a minute spent in comfortable and safe conditions imposes less cost to customers than the same minute spent in uncomfortable or unsafe conditions.

The concept of generalized cost provides several insights. The first is that transit can be made more appealing by increasing the cost of competing modes, such as personal vehicles. This explains why increased parking costs and transit priority measures can be so effective at promoting transit. [7] Parking costs directly increase the out of pocket cost of using a personal vehicle, and reduced parking availability can also increase total travel time due to time spent locating a parking spot. Transit priority measures reduce travel time by transit and may also potentially slow travel by personal vehicles. [7]

The other insights are related to the "value of time" (VoT), which is the out of pocket expense an individual would be willing to pay to reduce travel time. [7] For example, if an individual is willing to pay $10 more to reduce travel time by one hour that person's VoT would be $10/hr. The higher an individual's VoT, the more they will favor a shorter travel time over a lower out of pocket expense. Public transit tends to have a lower out of pocket cost but longer travel time than personal vehicles and is thus more attractive to those with a lower VoT. [3] VoT is typically considered to be higher for work trips than leisure trips and tends to increase with income. As such, it should not be surprising that those with higher incomes (and thus higher VoT) are less attracted to transit. [7]

1.3. Costs of Providing Transit Service

To understand transportation funding it is important to first understand the primary driving factors for the cost to provide transit service. An important distinction must be made between one-time capital costs and recurrent operating costs. Capital costs are incurred to construct, purchase or upgrade tangible assets such as facilities and vehicles. These costs are often very large, but the acquired assets typically have operational lives measured in decades. In contrast, operating costs are recurring costs for items such as wages and fuel used to provide transit service over a period of time (often a year). When compared to the capital cost for a given asset, annual operating costs for a given asset appear small. However, over the course of the life of that asset, operating costs are often several times larger than the capital cost. [3]

While capital and operating costs are used and funded very differently, they are often related in that larger capital investment often result in lower operating costs through improved efficiency. For example, a 60 foot articulated bus is more expensive than a standard 40 foot bus; however, the operating cost per rider is much lower because it is able to transport more passengers and only requires a single driver. When considered over the entire life of the vehicle (which may be 20 years or more), the cost savings from operational efficiency is often many times the additional capital cost. [3] However this generalization is not universally true, particularly when considering construction of facilities. [6] The details of capital investments are beyond the scope of this paper and so, beyond the brief summary above, discussion will be limited to only operating costs.

1.3.1. Operating Costs

The primary drivers of operating cost are payroll hours and fuel consumed, which are both directly linked to the amount of service provided, along with the type of service and when it is provided. [3] [8] In terms of operating costs, the "amount" of service is presented as either distance traveled or hours of service while type and time period are categories such as (bus, express and LRT) or (Peak, midday, evening). [9] Delays from passenger boarding and alighting also contribute to operating cost, although this is typically minimal unless vehicles are overloaded. Otherwise, ridership has little impact on operating costs. [7]

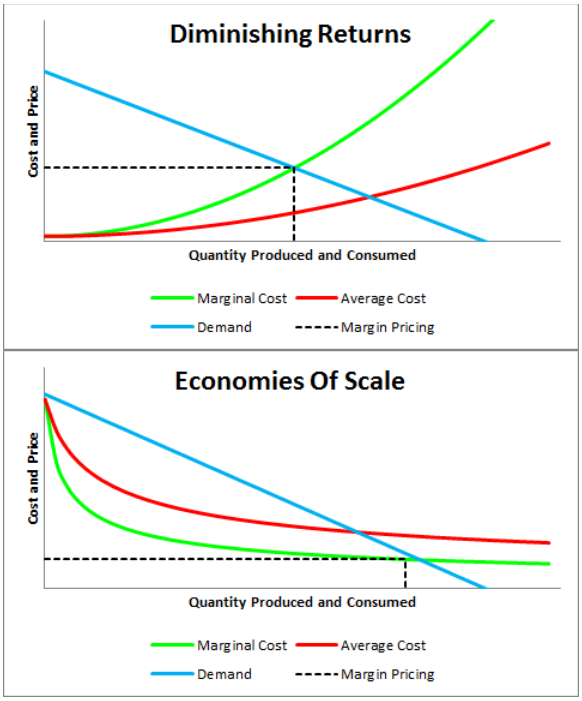
The operating cost per unit of service will vary dramatically between different types of service, due to factors such as stop frequency, type of Right of Way, and vehicle performance. [3] Frequently slowing down or stopping reduces travel speed while also increasing fuel usage and maintenance. As such, service on shared roads and with closely spaced stops is often more expensive to provide than express service separated from other traffic Vehicle type and Right of Way determine the type of fuel used and have a large impact in efficiency and maintenance. [3]

Providing transit service during peak periods is more expensive due to three factors. The first is that travel speeds tend to be slower due to road congestion and more frequent stops. The second is that peak demand is usually much higher in one direction than another and thus results in many vehicles with very low ridership traveling in the opposite direction. The third is that the fleet size, facilities and workforces must be designed to accommodate peak demand. During off-peak times demand is much lower, service is reduced and so vehicles and facilities are under-utilized. Under-utilization is inefficient because of the ownership and maintenance costs for the unused vehicles and over-sized facilities. Reduced off-peak service forces many operators to work "split shifts" with a break between AM and PM peaks. Such shifts are less desirable and thus tend to result in higher wages in collective agreements. [3]

1.3.2. Marginal Cost and Economies of Scale

Most goods and services can be priced using "marginal costs" or the cost to produce another unit of the good. Typically, as the number of customers using the good increases, the marginal cost increases due to "diminishing returns". Consumer demand declines with increasing price (which is assumed to depend on cost) and so the price can be set where the supply and demand are equal as shown in Figure 1 to the right. The marginal cost is always increasing therefore the average cost will always be less so setting the price at this point will provide some amount of profit (which is the area of the triangle between the green and red lines and the dotted black line). [7]

FIGURE 1: MARGINAL PRICING SCHEMES



However, transit does not follow this pattern. As mentioned in the previous section, ridership has very little impact on the cost of providing service. As such, as ridership increases, the marginal cost (cost per passenger) decreases, in an effect called "economies of scale". Decreasing marginal costs are always lower than average costs and so setting the price at the intersection point between marginal costs and demand will result in a loss (shown as the distance between the green and red lines). As such, a different method of determining the price must be used. [7]

1.4. Funding Transit Service

1.4.1. Sources of Funding (Revenue, Subsidies and Grants)

Unlike the majority of transportation infrastructure, most transit service requires that users pay a user fee or "fare". In order for transit service to be viable, the agency must obtain funding equal or greater to the cost of providing the service from revenue and operating subsidies and capital grants. The vast majority of revenue typically comes from user fees (fares) with supplemental revenue from advertising and special service contracting. [3] [9] Any funding not provided through revenue must be provided through public funding through subsidies or grants. [3]

Subsidies are usually provided by a government agency, but can also be provided by other types of organizations, such as non-governmental organizations (NGO's). These can take several forms, most typically cash or tax credits, and can be broadly available for any transit service, or limited to specific types of service (typically services to assist disadvantaged or vulnerable populations). While uncommon, some agencies receive funding from developers or business owners to encourage ridership to promote specific areas. Such funding may be considered either revenue or a subsidy. [3]

Grants are considered a form of subsidy since they are provided from public funds through government programs. Instead of ongoing funding to provide service, grants are one-time contributions to specific projects. Due to the high cost, it is not uncommon for large capital projects to be funded through multiple grants from several levels of government. [3]

As with many Canadian municipalities, the City of Edmonton is currently the sole provider of transit operating subsidies. [9] However, capital projects such as LRT expansion are possible only because of capital grants provided by the province and federal government [10].

1.4.2. Recovery Ratio

Both transit agencies and those providing subsidies carefully monitor the levels of funding provided through revenue and subsidies. The most common way to describe the level of subsidy is a ratio of the revenue collected and the total operating costs. This ratio is referred to as "Recovery" which is abbreviated as "R/C" and is often shown as a percentage. For example, a R/C Ratio of 0 (or 0%) means that revenue did not cover any costs, so subsidy must cover all of the costs. An R/C Ratio of 1 (or 100%) means that revenue covered 100% of costs, so no subsidy is required. [3] [6]

No R/C ratio is inherently better or worse than another, as long as it aligns with the agency's goals. Due to variety of such goals R/C values range from 0% to 100%, although values in the middle are most common. [3] Recovery can be considered in two ways. Agencies, such as ETS, have not determined a revenue target and so the R/C ratio simply is the financial shortfall between the cost of providing the service and revenue generated by it. [6] However, other agencies, such as Calgary Transit and OC Transpo in Ottawa, have established a target which represents the needs, values and finances of the communities being served. [11] [12]While establishing revenue targets is appealing, the lack of a financial target can provide the agency additional flexibility in the service provided, so long as funding is available. [3]

Recovery is the net effect of numerous factors; including available subsidy funding, ridership, service provided, fare structures and operational efficiency over which agencies have differing degrees of control. Most agencies have only marginal control over subsidy funding. Ridership is dependent on many factors, most of which the agencies have little or no control of. This topic is discussed in the Guiding Perspective Report on the Factors Affecting

Transit Ridership. The service provided and fare structures are partially controlled by the transit agency although municipal policies often impose limitations. Transit agencies typically have more control over operational efficiency although this is also dependent on the service provided as well as external influences such as road patterns in the service area and collective agreements. [3]

Full Recover & Full Subsidy

High Recovery (R/C > 90%)

High recovery service, as the name implies, is where revenue is able to cover nearly the entire operating cost of providing the service. Capital costs may also be covered, but often are at least partially funded by grants or loans offered by various levels of government. Full recovery systems are rare in North America, but more common where transit is privatized (at least in part) such as in Asia. Since revenue generation is largely dependent on demand, such systems are most practical in large, high-density cities, such as Tokyo and Beijing. [3]

In addition to being largely independent of public funding, profit driven agencies often provide very efficient and cost effective transit service. In some instances, such as Tokyo, multiple transit service providers may operate in competition with one another. Such systems may provide better connectivity, but also result in a more complicated network with multiple fare structures using separate fare media. [3]

However, full recovery service is likely to have higher fares. Individuals with low incomes and other vulnerable populations often depend on transit but may not be able to afford these high fares and often live in areas where service is unprofitable. [3] Ideally, revenue generated from profitable service can be used to provide discounted fares and to support unprofitable, but socially important service. However, this is not an assured outcome and so serious equity concerns may result.

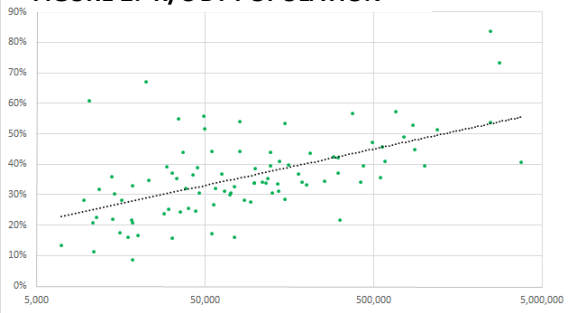
High Subsidy (R/C <10%)

At the other end of the spectrum are systems where fares account for very little funding or where no fare is collected at all. While such systems are supportive of low income groups, the level of service may not reflect ridership and so high demand corridors may be slow and overloaded. Furthermore the low priority of revenue may result in service which is less cost effective and agencies running such systems are likely to become less financially responsible. The dependence on heavy subsidies can result in a financial crisis if subsidy funding is ever reduced or entirely canceled. [3] While some transit agencies have a “free transit” portion of their network, very few entire systems have no user fees. Fare free public transit (FFPT) is discussed in more detail in section 2.4

Partial Subsidy (R/C 10%-90%)

Nearly all Canadian transit systems fall between these two extremes and collect a portion of their revenue from user fees and a portion from government subsidies. [9] Figure 2 plots R/C and population of transit systems reported by the Canadian Urban Transit Association (CUTA). Recoveries range from 84% (Vancouver Commuter Rail) to 9% (Fort St. John) with the majority between 20%-50%. While there are many exceptions, the R/C typically increases with population, as is shown by the dotted trend line. [9]

FIGURE 2: R/C BY POPULATION



2. FARE OBJECTIVES, STRUCTURES AND CONTROLS

2.1. FARE RATES & OBJECTIVES

2.1.1. OBJECTIVES AND REQUIREMENTS

In order to appreciate how fares are determined, it is important to understand what they are intended to accomplish. While the most obvious objective of fare rates is to generate revenue, they can also be used to encourage specific travel behaviors, help the less fortunate and support larger community goals. Common objectives for transit fares include:

- Generate Revenue
- Attract Ridership
- Change travel behaviors
- Support untargeted community goals (e.g. Urban form, Environmental & Economic Sustainability)
- Support targeted goals (specific areas of city or specific demographics) [13]

To better define how the fare structure is to be arrived at, agencies typically impose more specific requirements that the fare policy must comply with. Common requirements for transit fare policies include:

- Support fare objectives
- Reflect demand elasticity and related economic principles
- Reflect cost to provide the service
- Provide convenient payment options
- Be easily understood
- Minimize collection & enforcement costs [3]

2.1.2. CONFLICTING IMPACTS

As mentioned earlier, fare structures provide multiple fare payment options and have varying complexity and revenue generation potentials. Unfortunately, several of the goals and requirements mentioned above are in conflict with one another regarding the ideal complexity and revenue generation. The most obvious conflict is that "Generate Revenue" conflicts with the other objectives, which usually provide a discount or general fare reduction and thus reduce revenue. [13]

A similar conflict exists between complicated and simple fare structures. Objectives such as "Support Targeted Goals" and "Change Travel Behavior" – and requirements such as "reflect cost to provide service" and "reflect demand elasticity" – benefit from complex, flexible fare structures with many potential fare rates. For example, targeted discounts may be offered to help specific groups or encourage travel during off-peak times while premiums may be added to services that are more expensive to provide or which are in higher demand. However, complicated fare structures can be difficult to enforce and are always more confusing which can deter ridership. As such, the objective "Attracting Ridership" and requirements of "Be easily understood" and "Minimize Collection & Enforcement costs" typically benefit from more simplistic fare structures with fewer options. [14]

Clearly it is not possible to completely accomplish all of these goals while entirely meeting all of the requirements, so some form of compromise is needed. This compromise should reflect the relative importance of each of item and provide clear guidance administration can use to determine fare rates and policies.

2.1.3. Fare Subsidies

Fare subsidies occur any time that the fare paid by the passenger is less than the cost of providing the service and can be either "untargeted or "targeted." Fare subsidies that all riders can take advantage of are referred to as "Untargeted" while targeted subsidies are available only to a limited "target" subset of transit users.

Untargeted subsidies are often used to increase ridership by attracting riders who would otherwise travel by car. Common example is when an agency attempts to increase ridership by discounting the cash fare below the average cost per passenger. [3]

Targeted fare subsidies are intended either to support a targeted group or to encourage changes in travel behaviors. A variety of targeted subsidies are possible, with the most common being:

- **By group:** Fare subsidies targeted at a specific group of individuals can have two purposes. The most obvious is to support disadvantaged individuals, such as seniors and persons with disabilities, by reducing transportation costs. The second is to encourage the target group, such as students or youth, to adopt a transit-friendly lifestyle that will hopefully continue throughout their life. [13]
- **By Location**: Fare subsidies can also target users traveling to (or from) specific areas of the service area. Such subsidies can encourage pedestrian traffic to that area (typically a shopping district), or encourage ridership on a specific service (such as a new line or one that is seeing low ridership). [13] The 747 route to the Edmonton International Airport is an example.
- **By time period:** Subsidies can also be targeted at riders during specific time periods that can be implemented as a discount for off-peak travel or a premium on peak travel. Such discounts are intended to encourage travel during the discounted time period, typically to reduce the large difference in demand between peak and off-peak times during the weekday. [13]
- **Special Events:** Discounted or free fare is often available for special events such as fireworks displays, large sporting matches and festivals. These discounts increase attendance and reduce parking needs and traffic congestion at those events by encouraging attendees to use transit instead of personal vehicles. Where alcohol consumption is common, such service may also reduce the incidents of drinking and driving. [13]

2.2. Fare Structure Types

While the "fare rate" or "base fare" represents the price a passenger would pay for a single ticket, most agencies offer a variety of fare products at different rates that combine to form a "fare structure". Such structures range from simple "flat" fares that are always the same to those with many potential fare rates. Fare structures are typically based on three variables: distance traveled, time period, and user subgroups.

2.2.1. Flat fares

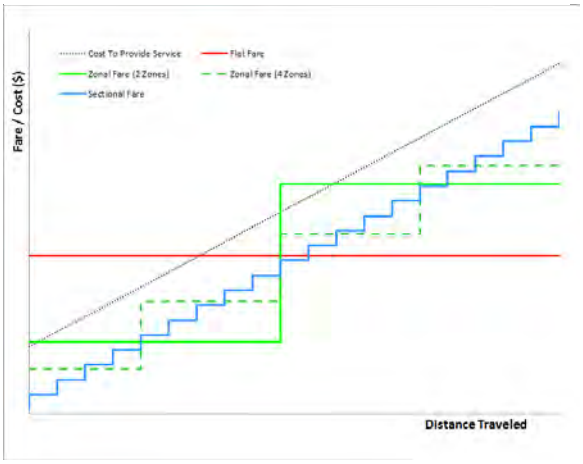
For each of those three variables, the simplest fare is one that is constant and thus "flat". In each case, the advantages of the flat fare are that it is simple to understand and collect. Thus passengers are always certain of the fare they will pay and computerized fare collection is not required. The drawback is that flat fare structures are less flexible and less equitable. The inequity results from the fare not reflecting the varying cost of providing the service or ability of the passenger to pay. [3] [13]

2.2.2. Fares Structured By Distance:

The rationale behind distance based or "graduated" fares is that the cost to transport a passenger increases with the distance the passenger travels due to additional fuel usage, vehicle wear and operator wages. The two

common types of graduated fares are "Zonal" and "Sectional", which are primarily differentiated by the size and number of payment increments. Figure 3 to the right shows how the fares change in several fare structures.

FIGURE 3: DISTANCE BASED FARES



ZONAL

The simpler method of graduated fare is "Zonal" where the service area is split into a small number of geographic zones (e.g. concentric rings around the city core). Travel within a given zone is the same price, but a higher rate is charged for trips that pass between zones. The location of the zonal boundary must be carefully chosen to prevent crossing by those making only short trips. Often a geographic boundary, such as a river, green belt or large corridor, already exists. If a significant number of short trips are crossing the boundary, a buffer can be used where individuals starting within the buffer are exempted from the cost of crossing it. [13] [3]

Zonal fares, shown in green in Figure 3, allow for a reduced base fare (compared to a flat fare), while also reflecting the cost to provide the service. Both of these benefits increase with the number of zones used, as shown by the dotted green line in Figure 3. However, this fare structure is more complicated and the fare collection system must be able to reflect the location of both the original boarding and final alighting of each passenger. As such, a more sophisticated payment collection system is required and cash fares can be problematic.

SECTIONAL

As the number of zones increases, each becomes smaller and thus the increase in fare at each boundary is reduced. Sectional fares result when this is taken to the extreme and each station represents a different zone. Such systems are able to very closely match the fare to the cost of providing the service, although passengers may not know how much they are being charged until after they alight. [3] [13] An example sectional fare is shown in blue in Figure 3 above.

CONTINUOUS

This is a further refinement made possible through modern technology where fares are calculated using actual distance traveled. A per km approach eliminates many of the cross zonal, cross sectional issues and the impacts on service design. It is also more equitable and potentially be easier to implement in a large, regional network.

2.2.3. FARES STRUCTURED BY TIME PERIOD

PEAK PREMIUM/OFFPEAK DISCOUNT

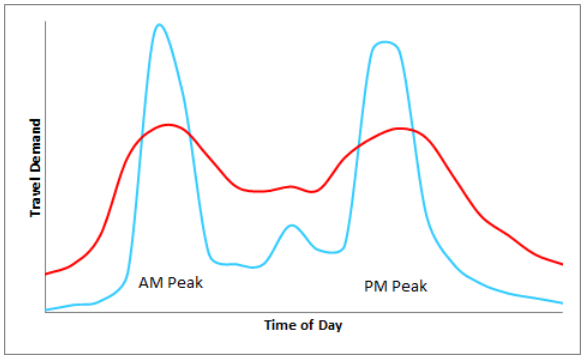
As mentioned previously, the cost to provide service does vary between time periods, with peak service typically being the most expensive. To reflect this, the agency can offer discounted rates for some or all off-peak times or charge an additional premium for travel during peaks. Both peak and off-peak times could be also further divided into additional time periods if desired. [13]

Peak pricing has several complementary effects. The first is that it allows for the fares charged to better reflect the cost of providing the service. The second is that it encourages passengers to shift their travel away from peak times to off-peak times. [14] The third is that the discounted rates during off-peak times could induce additional demand during off-peak times and thus increase total daily ridership. The cumulative effect is that demand

becomes more uniform with less variation between the peak and off-peak times. [3] Figure 4 to the right shows an example daily demand pattern (blue) and one with more uniform demand (red).

However, such pricing schemes are more complicated and use of transfer passes or pre-purchased tickets may be problematic. Another concern is that those with low incomes often have less control over their work schedules and thus are more likely to be subject to the higher fares than those with higher paying jobs. [3]

FIGURE 4: DAILY DEMAND PATTERNS



OTHER

In addition to peak pricing, discounts could be offered for other specific time periods (such as evenings or weekends). These may be implemented to promote events or to address problems specific to that time period (such as drunk driving late at night or congestion from large events letting out). [3]

2.2.4. FARES STRUCTURED BY GROUP:

Another important aspect of fare structure is discounts for specific subsets of riders. Unlike distance traveled or time period, such fare policies do not reflect the cost to provide the service. Instead, such discounts are used to accomplish community goals by assisting those with limited incomes, limited mobility or encouraging transit use among youth. Without targeted discounts, transit fares may become onerous to some individuals or even exclude them from the service entirely. [14]

LOW INCOME

Individuals with a low income are more likely to depend on transit since they are less able to afford a personal vehicle, taxi or other means of transportation. In addition, the cost of transit fare is a greater burden to them and may limit the areas where they are able to travel or work. [3] Reducing the fares for these individuals can allow them to better participate in the community, work at a greater range of locations, and also provide employers with a larger, more mobile labour market to draw from. Furthermore, improving employment opportunities might provide other social benefits to the community such as reduced use of welfare programs. [13] However a serious challenge for such programs is determining which individuals qualify for the program in an ethical and respectful manner.

CHILD/FAMILY

Families with small children have additional costs related to child care and often must take their children with them on daily trips. Children often accompany a parent on transit simply because the parent cannot leave the child alone. Where fare payment is required for children, the cost to travel effectively doubles (assuming a single parent and child). This burden is particularly difficult for those with low incomes, single parents, and those without access to child-care. [3] Discounted or free fares for small children are a common way to support families, although families with high incomes may also benefit from these policies. [3]

POST-SECONDARY STUDENT

Secondary and college students are a unique demographic in many ways. They are asserting their independence, learning about the world and developing many skills and routines that they will use the rest of their lives, and yet usually remain financially dependent on their families. Providing students with discounted transit fares allow the

students a greater opportunities while also reducing the financial burden on their families. [14] [13] In addition, transit use during these formative years is thought to make the student more likely to use and have a positive view of transit in their adult life. However, students can account for a large portion of riders and can overwhelm transit service near schools at dismissal. [3] Providing a discount to a large number of passengers can result in a significant loss of revenue. [2] Furthermore, discounted fares for students of high income families may pose equity concerns.

SENIORS

In both Canada and the United States seniors are commonly given special benefits or discounts on a number of services. This is largely because they often have limited incomes, reduced ability to drive and increased use of such services during times when demand is typically low (such as midday). However this may result in some degree of inequity as seniors with high incomes and who ride during peak times are still able to benefit from these discounts. [3] In addition, if seniors make up a large portion of the ridership, revenue losses may be significant.

PERSONS WITH DISABILITIES

Persons with disabilities face many financial and mobility obstacles, and yet they have a legal right to inclusion within their community. One common way to provide additional opportunities for inclusion is through discounts for such individuals and their caretakers. [3] As with low income discounts, determining qualifying individuals may pose challenges, however enrollment in programs such as AISH dramatically reduces this concern.

2.2.5. OTHER ITEMS:

A variety of other items can play a role in transit fare structures, including:

Premium service:

Where multiple modes or levels of service are offered, agencies may choose to charge more for higher quality service such as LRT or express lines. [12] [13] Such fare policies are one way to generate funding for service improvements, but may exclude those with low incomes from using the premium service. In addition, this tiered model may result in deterioration of less expensive services used by those unable to afford the premium services.

Transfers

Transfers are often required for users to travel between locations within the service area. While the user is making use of multiple routes, this is simply because no single route connects those specific locations. To allow for this, fares can allow for passengers to transfer between routes without additional payment. [3] To reduce the potential for abuse, these policies must impose limitations in how they can be used. For example, transfers may only be valid for a short time, restricted to only local bus routes or may only allow a single transfer. In order for such policies to be enforced some form of “transfer passes” may be issued. [3]

Special Events, Groups and Charters

Many transit agencies support local events by allowing for service to be customized for special events, large groups or chartered services. Such services may include customized routes and schedules that are very different from normal service and so often use a very different fare structure. For example, transit to a large sporting event may be free or chartered services may simply charge by the hour.

2.3. FARE COLLECTION & CONTROL

Fare collection and control are closely related and often performed simultaneously. Fare collection refers to how fares are paid, while "control" refers to how the system ensures the correct fares are paid. The fare collection and passenger control systems used by the agency must be able to support the fare structure. For example, a simple cash fare-box is not sufficient for a distance based fare because the operator (and potentially the traveler) will not know the total fare will be until the passenger alights. Table 2 below summarizes typical compatibility between collection, control and fare structures. In addition, fare collection should allow passengers a convenient form of payment, be cost effective to operate, and minimize negative impacts on passengers and operation. [3]

TABLE 2: FARE COMPATABILTIY MATRIX

		Fare Purchase Location						Fare Structure				Control Type				
		In Advance	Prior to Boarding	While Boarding	While Traveling	While Alighting	Exit station	Flat	Distance Based	Time	Group	Audit Only	Restricted Boarding	Payment on Boarding & Exit	Restricted Entrance at Station	station
Payment Type	Cash (no ticket)		X	X	X	X	X	X		S	S		X		X	
	Paper Ticket	X	X	X	X			X	S	S	X	X	X		X	S
	Prepaid Media	X	X	S				X	X	X	X	X	S	X	X	X
	Unlimited pass	X	S					X	S	S	X	X	X	X	X	X
Control Type	Audit Only	X	X	X	X			X		S	X					
	Restricted Boarding	X	X	X				X		X	X					
	Payment on Boarding & Exit	M	M	M		M			X	X	X					
	Restricted Entrance at Station	X	X					X		X	X					
	Restricted Entrance & Exit at station	M	M		S		M		X	X	X					
Fare Structure	Flat	X	X	X	X	X	X									
	Distance Based	M	M	M		M	M									
	Time Based	S	X	S	X	X	X									
	Group	X	X	S	X	X	X									

X Easily Adaptable
S Requires Special Accommodation
M Payment at origin and destination

2.3.1. PAYMENT METHODS (FARE MEDIA)

Several fare payment options are commonly used, each with advantages and drawbacks:

Unlimited use passes: Such passes allow for any number of uses but are typically valid for a specific amount of time (often a month or year). Such passes may have limitations on who can purchase them, when they can be used and what types of service they can be used on. [3] These passes can dramatically simplify fare payment and control but require users to purchase and maintain a potentially expensive pass for the entire period of validity.

Passes are technically compatible with any type of fare structure, although the traveler does not actually pay a fare for any specific trip and so the passholders are exceptions to fare structures based on distance or time of day. Any type of collection and control method can be adapted to use unlimited passes, although manual confirmation by an operator is often required for cash box systems.

Stored Value Farecard: This may be in the form of a paper ticket or a plastic card linked to an account with an initial balance. The fare is then deducted from that account each time the media is used. The account may allow for additional deposits or the media may simply expire once the account is entirely spent. Stored value farecard media allows more complex fare structures and removes the need for ticket collection or cash on vehicles. However, this requires a complicated system to maintain the large number of account balances which must be reliable and secure. In addition, passengers must purchase the media ahead of time, maintain it in a usable state and ensure the adequate funds remain in the account. Stored value farecard can be adapted to any type of fare structure and any control type, although simpler systems may need to be upgraded [5].

Paper tickets & transfers: Single use paper tickets may be collected or validated as payment. Some systems provide paper "transfer passes" to passengers that are either taken upon use or expire after a short period of time. Paper tickets are potentially easier for passengers than cash or stored value farecard as they are single use and can be purchased in bulk. However, the tickets must still be purchased ahead of time, are easy to lose or damage and can generate significant waste paper. Paper tickets work well with flat fare structures and those where some groups can purchase them at a discount. Tickets can be sold at any time prior to alighting and work well with forms of control that do not require processing media at two points. However, paper tickets are difficult to use with distance or time based fares. [13]

Cash: Systems that have a cash fare-box allow for passengers to pay without having to first purchase special media. However, riders must provide exact change which can be problematic and time consuming. Furthermore complex fare structures are not practical and storage and handling of a potentially large amount of cash can introduce additional security concerns. While possible, cash is often only practical with flat fare structures as other options are often frustrating for passengers or require labor intensive collection and control. [13]

2.3.2. Fare Purchase Locations

The location where payment is to be made must also be considered, and must be compatible with the type of payment and control used. Fare payment can typically take place at one or more of six points in the trip:

Prior to traveling: Period passes can be purchased well in advance of the trip and simply presented when requested by agency staff as proof of payment. As payment is not part of the trip, no delays to the user or the vehicle are likely to result. Nearly every type of fare structure, control and payment type can be adapted to support purchased in advance of traveling, although distance based fares require processing of media at the end of the journey as well.

Prior to boarding (at a station, but off-vehicle): Passengers must provide payment (or proof of payment) when entering the station (or a platform at the station). This option may result in delays to passengers but will not delay vehicles. With the exception of passes with a photo-ID, most any fare structure, control method or media type can be sold at stations, although distance based fares require processing of media at the end of the journey as well. [3]

While boarding (on vehicle): Payment is provided by each passenger during boarding. This option has the greatest potential for delays to both passengers and vehicles. Typically only a single passenger may pay at a time and so if any passenger runs into difficulties, other boarding passengers and the vehicle itself must wait. In order to prevent delays, only cash fare and paper tickets are practical upon boarding. Flat fare structures are the most

suitable for payment at boarding, although distance based fare and stored value farecard can be used, but the media must typically be purchased ahead of time. [3]

While traveling (on vehicle): On longer trips (and larger vehicles) it may be practical for payment to be made during the trip. This method requires adequate time between stops for passengers to purchase fare and so is typically only suitable for regional rail lines. While potentially able to support all but distance based fare structures, this is difficult to enforce and usually requires conductors selling fare and verifying fare payment. In addition a serious problem can arise should passengers be unable or unwilling to pay for fare, as they are already on the vehicle. [3]

While Alighting (on vehicle): Payment while alighting is primarily used for distance based fares, as the rate is partially determined by the end location. In such cases, this is the second point at which the media is processed, with the first being at the beginning of the trip. [3] Similar to payment while boarding, multiple passengers exiting at once or any payment difficulties may result in delays for passengers and the vehicle. Enforcement can be very difficult if the only point of payment is at the end of the trip.

Exiting the station (at a station, but off-vehicle): Payment at the destination station is primarily used for distance based fares, as the rate is partially determined by the end location. [13] In such cases, this is the second point at which the media is processed, with the first being at the beginning of the trip. Similar to payment while boarding, multiple passengers exiting at once or any payment difficulties may result in delays for passengers and the vehicle. Enforcement can be very difficult if the only point of payment is at the end of the trip [3]

2.3.3. Control methods and Locations:

In order to ensure passengers purchase the correct fare, some means of control must be provided. A number of options are available, ranging from fare boxes to electronic barriers. The method of control must be carefully chosen to provide the necessary enforcement of fare compliance, accommodate travel volumes and minimize the cost to the agency and the impact to passengers. Several types are commonly used:

Audit inspection: Enforcement agents routinely patrol vehicles or stations and demand passengers show proof of payment. If proof is not given, the passenger must then purchase fare, and often pay a penalty. This control method, currently used on the LRT in Edmonton, is simple for passengers, unlikely to cause delays and requires very little infrastructure. However, this method is labor intensive, incidence of non-payment may increase unless other controls are used, and may pose security concerns from patrons unable or unwilling to pay. Audit is not practical for any system where any form of payment is made at the destination or where distance based fares are used. [13]

Restricted boarding: As each traveler boards, they must pay or present proof of fare payment, typically to the operator. Any passengers failing to do so are denied entry to the vehicle. This method is simple for passengers to use and requires minimal infrastructure, as only a fare box is required on each vehicle. However, passenger and vehicle delays are common, the operator must be able to identify all fare media types, hurried boarding may allow for passenger non-payment and fare disputes may endanger the operator. Restricted boarding is currently used on ETS buses. Restricted boarding is easily adaptable to most types of media, fare structures other than those where some or all of the payment is made at the destination, such as distance based fares. [3] [13]

Restricted Entrance at stations: This type of control is used on many large metro systems that use a flat fare such as Montreal and New York. Users can only access the transit vehicles by first entering a controlled area at a station. Each station is constructed with barriers that prevent entrance to the controlled areas until payment is proven (for example by means of a turnstile or gate). By moving control away from the vehicle, conflicts from non-

payment and potential delays are moved as well. Properly designed stations can allow for many passengers to quickly provide payment simultaneously, which minimizes the opportunities for passenger non-payment and better contains fare disputes. However, this method of control requires a large amount of infrastructure as each stop must be at a station with the required control barriers. Additional labor is often required to maintain control barriers and provide the needed level of security at each station.

Restricted entrance and exit at stations: This method, used on metro systems in cities such as Beijing, London and Tokyo, is simply an extension of "restricted entrance at stations" where graduated fare is used. Prepaid fare media must be processed both to gain access at the origin station and to exit at the destination station. This form of control, provides the benefits of graduated (distance based) fares but also requires additional infrastructure be provided to process fare media twice. [3]

Payment on Boarding & Exit: If a graduated fare is desired on lines that do not exclusively use large stations, such as bus and tram lines, the payment systems must be on the vehicles themselves. Historically this required conductors to collect payment from passengers as they exited; the most famous example of such a system was in Boston where it inspired the protest song "M.T.A." which became a hit in 1949. [15] Modern payment systems use stored value farecards which are tapped or swiped by electronic card readers both when the passenger boards and exits the vehicle at a device similar to the one shown in Figure 5. Typically, the maximum fare is deducted from the media upon boarding and a credit is given upon exiting the vehicle, thus reducing the incentives for non-payment on exiting the vehicle. This method of payment, sometimes referred to as "tap on - tap off," allows for distance based fare policies without complex stations. However, this system requires each passenger to spend time processing fare twice, requires two fare processing units on each vehicle, and fare disputes may put the driver in danger. In addition, a complex computerized system must be used to track transactions for each cardholder and to process each payment. This type of system, currently used in Greater Toronto and Sydney, is being considered by ETS for the future "SmartFare" system. [12]

FIGURE 5: ONBOARD TAP PAYMENT

2.4. FARE-FREE PUBLIC TRANSPORTATION (FFPT)

As mentioned in previous sections, fare collection and enforcement can be costly and reducing fare rates is thought to increase ridership and support community goals. As such, eliminating fares should, logically, maximize the benefits of transit and remove the cost of fare collection. This train of thought has occurred many times and been tested in dozens of municipalities throughout the world, particularly in the 1960's and 1970's. [4]

As would be expected, the results varied with some areas continuing the programs permanently and others being discontinued after only a short period. The reasons for this are discussed in more detail below, but the consensus appears to be that FFPT is problematic for most municipalities and usually only successful in three types of communities: [4]

1. Small urban areas with modest ridership and large rural areas with low ridership, as fare revenue only accounts for a very small fraction of the cost of providing the service.

2. Resort communities that carry significant numbers of passengers as populations swell inordinately during tourist seasons (where it is considered a vital component of what makes the community attractive to visitors).
3. University-dominated communities where the clear majority of passengers in the service area are college students, faculty, and staff.

2.4.1. FINDINGS

Regardless of the level of success, nearly all agencies saw three common impacts. The first was dramatic increase in ridership. This was most often about 50%; however some agencies saw increases of as much as 200%-1,000%. [4] Unfortunately, the majority of these additional trips were not made by motorists switching to transit, but by those who would have used active modes and transit users simply traveling more often. The second impact is improvements in operational efficiency by removing the need to collect or enforce fare payments. In addition to reducing manpower and infrastructure needs, buses could allow boarding and alighting from all doors. The third impact is a loss of revenue from the fares that are no longer being collected. [16]

In North America agencies that were successful with FFPT are all small transit systems with fewer than 100 buses. [4] Agencies of this size typically experience comparatively low ridership and often serve less diverse populations and have less dependency on fare revenue than larger agencies. These characteristics provide advantages over larger systems. The existing low ridership implies significant unused capacity on transit vehicles and routes, which is able to accommodate the increase in ridership without significant additional cost. For reasons that are not well understood, service areas with relatively homogeneous populations tend to see lower levels of vandalism and hooliganism on transit systems. [16]

Several of the successful agencies were previously operating with as little as 9% of the operating funds coming from fare revenue. To allow for this, subsides were provided either by state grants, community taxes or local businesses. [16] In some instances, where grant funding was based on ridership, fare elimination actually saw a net increase in funding for the agency due to the increase in ridership. Municipalities that are dominantly related to tourism saw free transit as a competitive advantage and those with a large university were often able to secure funding from the student body. [4]

Agencies where fare free public transit was not successful typically sited two fundamental reasons for the failure. The first is that the removal of fares saw a dramatic increase in unruly behavior and vandalism that reduced safety and comfort of passengers. The underlying cause of the behavior is unclear; however the reduction in security drove many choice riders away from transit. The second is the financial burden from the loss of fare revenue, which was made worse by cost increases due to increased ridership, vandalism and provision of additional security. [16]

2.4.2. PARTIAL FARE FREE PUBLIC TRANSPORTATION

While system wide fare free public transportation is often problematic, many agencies are able to provide a limited free transit service. Such service can be limited in three ways. The first is to confine the free service to a small geographic area, such as a business district or university. The second is to limit the service temporally, either to specific time periods, or to specific calendar dates. The third is to limit the service to specific subgroups of riders, typically veterans, seniors, or the disabled. It is not uncommon for free service to also be limited to a specific mode (typically the lowest quality service). [4]

FFPT service limited to a small geographic area is most effective in areas that benefit from high volumes of pedestrian traffic, where space is not available for wide roads and parking lots and where a high ridership demand

is already present. Common examples of such areas are shopping districts, downtowns and universities. Free transit to these areas is often beneficial for businesses and residents in the area served, who may be willing to fund the free service. [4]

Three types of time limited free transit are commonly used. The first is free transit service for special events, which may be also limited to only specific lines or areas. Common examples are holiday celebrations, festivals and popular sporting events. In addition to promoting the event, such service is often needed due to limited space for parking and/or potential safety concerns from high volumes of vehicle and foot traffic. [4] The second type is a short term free service intended to promote the transit system itself. This might be on a newly opened line or a system wide promotion such as "Try Transit Week" offered by Virginia Department of Rail and Public Transportation. The third type is to provide free service during specific off-peak time periods. [4]

Many transit agencies offer free transit to one or more demographics. The most common in North America is for children under the age of five. [9] Other demographics include military veterans, seniors and individuals with disabilities (or their caretakers). Such service is an attempt to promote social health of the community and the groups who are offered such service are often small enough that the cost is negligible. [4]

3. Edmonton Context

This section discusses the fares and finances of transit service in Edmonton.

3.1. Fare Structure

3.1.1. Overview and Comparison

The different fare structures for Edmonton, Calgary and Ottawa are shown in Table 3. In terms of cash fares, ETS only offers a single cash fare ($3.25) for all trips other than service to the airport. [17] Calgary uses a similar structure although with a slightly lower cash fare ($3.15) and a discount for youth ($2.10). [18] Ottawa has a very different structure with separate prices for each type of passenger ($3.55 to $1.90), and an additional "Top Up" fee ($1.45) to use express routes. [19]

TABLE 3: FARE STRUCTURES 2016

Fare Type		Edmonton	Calgary	Ottawa
Cash	Adult	$3.25	$3.15	$3.55
	Senior			$2.70
	Youth		$2.10	$1.90
	Airport	$5.00	$9.50	$3.55
	Express "Top Up"	N/A		$1.45
Bulk Purchase	Adult	$24.75	$31.50	Discount if prepaid
	Youth/Senior	$21.50	$21.00	
Day Pass	Adult	$9.25	$9.50	$8.30
	Youth		$6.75	
Monthly Pass	Adult	$91.50	$99.00	$103.25
	Youth	$69.00	$65.00	
	Student	$83.50	$99.00	$82.25
	Senior	$14.50		$41.75
	Adult Express	N/A		$127.50
	Student Express	N/A		$96.50
	Senior Express	N/A		$41.75
	AISH	$35.00	N/A	$41.75
	Low Income	N/A	$44.00	N/A
	ETS @ WORK	$69.54	N/A	N/A
Annual Passes	Senior	$128.75	$95.00	N/A
	Senior Low Income	$55.75	$15.00	
U-Pass (Per term)		$170.00	$130.00	$184.50

For bulk purchases, Edmonton Transit offers a 24% discount for purchasing tickets in packs of 10, and a further 10% discount for youth and seniors. In contrast, Calgary offers packs of 10 tickets with no discount and Ottawa offers varying discounts for using prepaid options such as the refillable "Presto cards" and single use "bus tickets." [19]

The most dramatic differences are in the offerings of unlimited use daily, monthly and annual passes. Edmonton offers only a single daily pass ($9.25) and 6 types of monthly passes ($14.50 to $91.50) with the deepest discounts being given to seniors ($14.50) and persons with disabilities ($35.00). [17] Calgary has a higher price for adult daily ($9.50) and monthly passes ($99.00). While Calgary offers no discounts to students or seniors, they offer discounts to youth ($6.75/day & $65.00/Month) and on monthly passes for low income individuals ($44.00). [18] Both Edmonton and Calgary only offer discounted

annual passes to seniors, with Calgary offering them at much lower prices than Edmonton. Ottawa has a very different fare structure for unlimited use passes. Only a single daily pass ($8.30) is offered and no annual passes available. While seniors and persons with disabilities may purchase a discounted pass ($41.75) that is valid on all routes, adults and students must choose between regular passes ($103.25 & $82.25) or more expensive passes ($127.5 & $96.50) that also allow use of express routes. [19]

All three systems offer a U-Pass program for university students, with the price offered by ETS ($162.50) being between the offerings in Calgary ($130.0) and Ottawa ($184.50).

3.1.2. Subsidy and Cost

The R/C Ratio and subsidy for each current fare type is shown in Table 4 to the right. The greatest discounts offered by ETS are to the low income seniors at 96%, followed by all seniors (86-90%) and university students (77%) and all other discounts less than 60%.

The total subsidy and R/C Ratio for each fare type in 2014 is summarized in Table 5 below. As is shown, only cash fares, which account for 7% of ridership, did not require any

TABLE 4: RECOVERY BY FARE TYPE

Fare Type	Fare Rate	Subsidy	R/C
Cash	$3.25	-$0.05	102%
Airport Adult Pass	$5.00	$1.33	79%
Adult Tickets (10's)	$24.75	$7.25	77%
Day Pass	$9.25	$3.55	72%
Youth/Senior Tickets (10's)	$21.50	$10.50	67%
Adult Monthly Pass	$91.50	$94.10	49%
jk	$69.00	$78.20	47%
Post Secondary Monthly Pass	$83.50	$102.10	45%
ETS @ WORK	$80.52	$105.08	43%
AISH Monthly Pass	$35.00	$51.40	41%
U-Pass (4 month term)	$162.50	$439.10	27%
Senior Monthly Pass	$14.50	$91.10	14%
Senior Regular Annual Pass	$128.75	$1,138	10%
Senior Low Income Annual Pass	$55.75	$1,211	4%

Assumes cost to provide service is $3.20 and multipliers used in budget

TABLE 5: TOTAL COST OF ETS FARE TYPES

Fare Type	2014 Revenue		2014 Ridership		Total Subsidy for Service	Average Per Trip		
	Value	%	Passengers	%		Paid	Subsidy	R/C
Cash	$19,523,894	15%	6,135,441	7%	($122,709)	$3.20	-$0.02	101%
Airport Adult Pass	$258,800	0%	103,520	0%	$70,394	$2.50	$0.68	79%
Adult Tickets (10's)	$17,477,876	14%	7,283,222	8%	$5,680,913	$2.40	$0.78	75%
Day Pass	$268,350	0%	119,331	0%	$110,977	$2.25	$0.93	71%
Youth/Senior Tickets (10's)	$1,961,141	2%	959,372	1%	$1,093,684	$2.04	$1.14	64%
Adult Tickets (20's)	$851,341	1%	473,040	1%	$652,795	$1.80	$1.38	57%
Adult Monthly Pass	$34,473,044	27%	22,498,780	25%	$37,122,987	$1.53	$1.65	48%
Youth Monthly Pass	$17,493,432	14%	11,636,988	13%	$19,550,140	$1.50	$1.68	47%
Post Secondary Monthly Pass	$764,964	1%	547,752	1%	$974,999	$1.40	$1.78	44%
ETS @ WORK	$5,720,769	4%	4,325,466	5%	$8,045,367	$1.32	$1.86	42%
AISH Monthly Pass	$1,997,100	2%	1,540,620	2%	$2,896,366	$1.30	$1.88	41%
U-Pass	$17,720,755	14%	25,958,241	29%	$64,895,603	$0.68	$2.50	21%
Senior Monthly Pass	$1,039,332	1%	2,449,953	3%	$6,761,870	$0.42	$2.76	13%
Senior Regular Annual Pass	$435,608	0%	1,353,396	2%	$3,870,713	$0.32	$2.86	10%
Courtesy Pass (Special Events)	$47,857	0%	328,462	0%	$995,239	$0.15	$3.03	5%
Senior Low Income Annual Pass	$411,696	0%	2,918,256	3%	$8,871,498	$0.14	$3.04	4%
Transit Employees	$0	0%	651,168	1%	$2,070,714	$0.00	$3.18	0%
Other Revenue	$6,900,000	5%	N/A		($6,900,000)	N/A	N/A	N/A
Total	**$127,345,959**		**89,283,007**		**$ 156,641,549**	**$1.43**	**$1.75**	**45%**

Fares and Ridership values are from Dec 2015 SRR Report. Costs assume $3.18 per passenger trip. "Other Reveneu" estimated from CUTA Data

subsidy. While the price of senior fares, transit employees and courtesy passes had the lowest levels of recovery, together they make up less than 10% of the ridership and cost only $22 million. The costliest services to provide were U-Pass ($64 million), followed by monthly passes for adults ($37 million) and youth ($19 million) due to high usage and low recovery ratios. More than 2/3 of all transit riders take advantage of either a U-pass or a monthly pass and the total cost accounts for almost 75% of the subsidy for ETS service.

3.1.3. CHANGES OVER THE LAST 10 YEARS

Changes to the ETS fare structure from 2006 to 2016 are summarized in Table 6. Fare categories that were not consistently been offered over this time have been excluded (ex: Airport Route 747, ETS @ Work and 10 or 20 packs). Rates of growth vary between the various fare types with cash and adult monthly passes growing 44.4% and 55.1% respectively. AISH and Senior Annual Passes grew the least at 20.7% and 22.6% respectively. U-Pass and Youth monthly passes grew the most at 88.9% and 64.3% respectively. [20]

TABLE 6: ETS FARE RATES 2006-2016

Fare Type	2006	2016	Growth
Cash	$2.25	$3.25	44.4%
Adult Monthly Pass	$59.00	$91.50	55.1%
Seniors Monthly Pass	$11.00	$14.50	31.8%
Youth Monthly Pass	$42.00	$69.00	64.3%
Senior Annual Pass	$105.00	$128.75	22.6%
Senior Low Income Annual Pass	$45.00	$55.75	23.9%
Post Secondary Monthly Pass	$54.00	$83.50	54.6%
Day Pass	$6.75	$9.25	37.0%
AISH Monthly Pass	$29.00	$35.00	20.7%
UPASS	$90 (2007)	$162.50	80.6%

The evolution of ETS fares is described in the following passage from the recent report written by the city auditor:

> *Transit fares and changes to the transit fare structure have been presented and approved in the annual operating budget process*
> *There is no policy in effect that answers questions regarding the intent of the fare categories, the rationale for the discounting of fares, nor the expectations for those discounts in terms of additional ridership or nonmonetary gains for the transit system or the City as a whole. The existing fare structure does not recognize the elements of service that are driving costs upwards, rather it favours the needs of the consumer over the realities of fiscal constraints for the system as a result of the subsidy of fares. The resulting review has found that there was a lack of process surrounding the understanding of what fares were intended to do and how that intent should manifest itself in terms of fare structure*
> *Ultimately, fare structure needs to be the outcome of a greater strategic plan encompassing an understanding of why transit matters to a city, how funding strategies will be used to meet transit objectives, and how the structure of fares will be used to encourage ridership onto the system in order to meet specific goals.*
> *The OCA recommended that Administration a) Engage City Council in a discussion on the societal benefits of public transit; b) Establish a revenue/cost ratio target that conveys the value City Council places on societal benefits; and c) Establish a fare procedure that sets out the fare structure.*

3.1.4. REGIONAL INTEGRATION

Public transit in the "Capital Region" is dominated by Edmonton Transit, but also includes Strathcona County Transit, St. Albert Transit, Leduc Transit and contracted service provided by ETS for Spruce Grove and Ft. Saskatchewan. The "Regional Transit Fare System & Implementation Plan" prepared by the Capital Region Board in 2013 describes the current fare structure as:

> *"..there are currently 150 or more ways to pay a transit fare and each of the eight transit systems [in the Capital Region] has a unique fare system that meets the needs of the individual municipalities and their riders but on a regional basis is 'dysfunctional."* [21]

And then later describes transfers between agencies as:

"Transit passengers in the Capital Region face numerous fare barriers that require them to carefully plan their journey, and pay multiple fares or surcharges to cross municipal boundaries. In some instances the fares they are paying are not approved by any governing board or authorized in any written agreement. The fares may be subject to hidden discounts or actually be higher in one direction than the other." [21]

Similar comments are given in a fare review done for ETS by Stantec later in 2013 and both documents mention the need for a regional fare structure. [1] Those reports also stated that a graduated fare structure will be required which is not practical with the current cash fare boxes used by ETS. As such they recommend transitioning to an electronic "smart fare" system.

3.2. System Wide Finances

3.2.1. Current

In 2014, the cost of providing all transit service in Edmonton was $288 million of which $127 million (45%) was generated by revenue and $156 million (55%) was provided as a subsidy from the City of Edmonton. This equates to a recovery of 45%. This is the average for CUTA population group 2, but is below both Calgary and Ottawa.

3.2.2. System-Wide Trends

Table 7 summarizes key trends over the 10 year period from 2004 and 2014. During this period, Edmonton has grown by approximately 24% while transit ridership grew 68%, and distance traveled on transit grew by 88% as shown in Figure 6. This indicates that more Edmontonians are using transit and they are using it to travel farther. During this time, total revenue has also more than doubled (105%) however, the total cost of providing this service has grown even more dramatically (113%) and so the total operating subsidy had to increase by 121% and R/C has fallen by 3%. This shortfall is surprising in light of the 60% increase in base fare (Adult Cash Fare), which highlights the impact of discounted fares. Figure 7 shows the progression of cost, revenue and subsidy over this time in greater detail.

TABLE 7: ETS COST AND REVENUE 2004-2014

	2004	2014	Growth (%)
Population	707,271	877,926	24%
Passengers	53,051,986	89,283,008	68%
Passenger-Km	371,363,902	696,407,462	88%
Direct Operating Costs	133,920,212	283,890,963	112%
Total Operating Costs	135,662,631	288,865,080	113%
Fare Revenue	$59,782,547	$120,757,270	102%
Total Operating Revenue	$64,170,470	$127,443,011	99%
Total Revenue	$64,661,874	$132,288,874	105%
Total Subsidy	$71,000,757	$156,576,206	121%
R/C	48%	45%	-3%
Adult Cash Fare	$2.00	$3.20	60%
Ave Fare Paid	$1.13	$1.35	20%
Cost Per Rider	$2.52	$3.18	26%
Subsidy Per Rider	$1.34	$1.75	31%
City Contribution Per Capita	$100.39	$178.35	78%

FIGURE 6: RIDERSHIP & POPULATION GROWTH

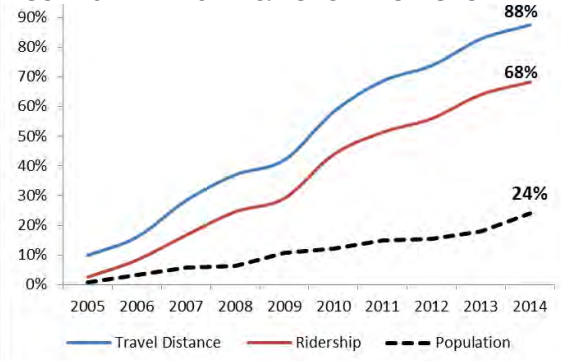
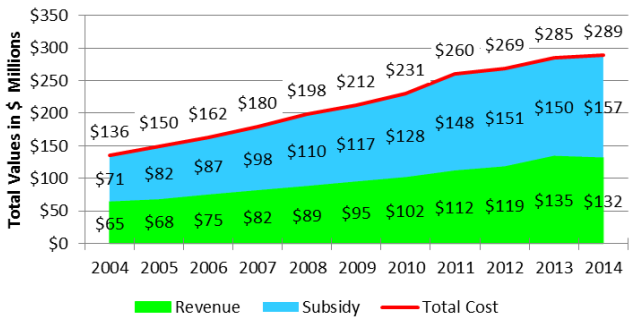


FIGURE 7: TOTAL ANNUAL COSTS & REVENUE



Over this time the population of Edmonton and amount of service both grew substantially and so it is important of consider these in terms of ridership, distance and capita. Figures 8 and 9 show the average fares, costs and

subsidy per passenger between 2004 and 2014 as monetary values and percentage increases. Figure 8 details how costs per passenger have outpaced the average fare paid requiring additional subsidy. Figure 9 shows that both average fare paid and cost per passenger-kilometer have both grown slower than inflation. The cost per passenger has regularly exceeded inflation due to passengers traveling further on average. [22]

FIGURE 8: AVERAGE COSTS & REVENUE PER PASSENGER

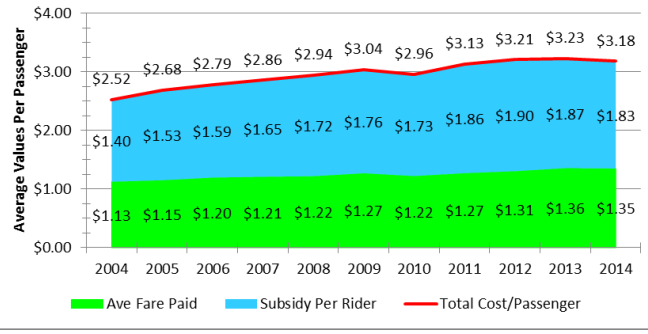
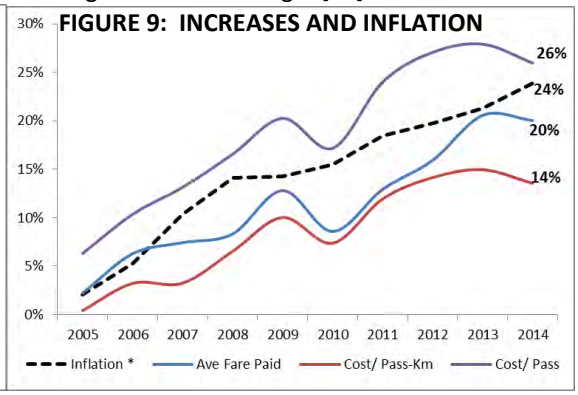


FIGURE 9: INCREASES AND INFLATION



3.2.3. COMPARISON WITH OTHER MUNICIPALITIES

In addition to identifying trends over time, ETS reports data to the Canadian Urban Transit Association (CUTA), which compiles specific data from 103 municipalities that are grouped in population categories to provide a means to compare performance. CUTA information relates to the financial and functional operation of the system along with the size of the city, but does not include information on geography, culture, financing, wealth or strategic goals. [9]

For comparison, municipalities are grouped into categories based on their population with Edmonton being in population group 2 (400,000 to 2,000,000). Due to the diversity within this group, it is also useful to compare Edmonton against a subset of these municipalities that are more similar to Edmonton. In previous reports such as the "Transit Review" and ETS audit, Edmonton was compared to Ottawa and Calgary. [9] Table 8 below summarizes many of the key items reported by CUTA in 2014, which is the most recent data.

TABLE 8: 2014 CUTA DATA SUMMARY

Service Area			Ridership			Fare				Other		
Municipality	**Pop (000's)**	**Size KM²**	**Trips (000's)**	**Per Capita**	**Per Rev Veh Hr**	**Adult Cash Fare**	**Ave Paid**	**Cost / Rider**	**Sub / Rider**	**R/C Ratio**	**Cost / Hr**	**Rev Hrs / Capita**
Montréal	1,938	501	417,220	215.3	61.8	$ 3.00	$1.43	$ 2.56	$1.13			3.490
Calgary	1,195	896	110,275	92.3	44.0	$ 3.00	$1.59	$ 3.35	$1.63	0.512	$ 131.45	2.095
York Region	1,003	1,776	22,445	22.4	18.3	$ 4.00	$2.87	$ 7.35	$4.44	0.396	$ 123.29	1.226
Edmonton	878	700	89,283	101.7	41.1	$ 3.20	$1.35	$ 3.18	$1.75	0.449	$ 127.27	2.476
Ottawa	858	466	97,077	113.2	44.2	$ 3.45	$1.85	$ 3.60	$1.70	0.527	$ 139.78	2.558
Mississauga	756	179	36,608	48.4	27.8	$ 3.25	$2.03	$ 4.43	$2.26	0.490	$ 115.14	1.742
Winnipeg	675	229	49,868	73.8	35.6	$ 2.55	$1.55	$ 2.80	$1.20	0.572	$ 91.59	2.074
Québec	585	548	46,610	79.7	39.9	$ 3.25	$1.39	$ 3.79	$2.24	0.408	$ 130.22	1.999
Brampton	564	267	20,411	36.2	21.4	$ 3.75	$2.46	$ 5.50	$2.99	0.457	$ 108.42	1.691
Durham Regio	550	406	10,791	19.6	21.2	$ 3.25	$2.10	$ 6.13	$3.95	0.356	$ 121.22	0.927
Hamilton	490	235	22,234	45.4	30.5	$ 2.55	$1.65	$ 3.56	$1.88	0.473	$ 101.67	1.488
Waterloo Reg	434	217	21,597	49.7	32.3	$ 3.00	$1.38	$ 3.61	$2.19	0.394	$ 110.56	1.541
Laval	421	245	21,564	51.2	35.4	$ 3.25	$1.46	$ 4.49	$2.97	0.340	$ 111.42	1.444
Longueuil	411	282	34,448	83.8	41.5	$ 3.25	$1.66	$ 2.30	$1.68	N/A		2.020
Average	**769**	**496**	**71,459**	**73.8**	**35.3**	**$ 3.20**	**$1.77**	**$ 4.05**	**$2.29**	**0.448**	**$ 117.67**	**1.912**
ETS Rank	*4 of 14*	*3 of 14*	*4 of 14*	*3 of 14*	*5 of 14*	*9 of 14*	*14 of 14*	*11 of 14*	*9 of 14*	*7 of 13*	*4 of 12*	*3 of 14*

In general, Edmonton compares well to the population group and the smaller subset. Particularly, the system appears to be very efficient having one of the lowest costs per passenger ($3.18) and a cost per hour ($127.27) below both Calgary and Ottawa.

In terms of finances, ETS has the single lowest average fare paid ($1.35), which is well below the group average ($2.29) despite the adult fare being at average ($3.20). This is likely to be due to both high levels of discounts and a large number of riders who take advantage of them. The high operating efficiency is able to offset the low revenue enough for recovery to be at the group average (45%), although below both Calgary (51%) and Ottawa (53%) [9].

3.2.4. Value of Transit

Another way to consider use of public funds for a subsidy is in terms of the relative costs and the value of the benefits. In 2013, the City of Edmonton used the "Regional Transportation Model" (RTM) to estimate the value of direct benefits from transit service. These were estimated by modeling the transportation network if transit service was completely canceled and all passengers used other modes of transportation. This model was run using conservative assumptions and limited only to short term items such as the cost of auto ownership and impact of congestion. Social, economic and environmental impacts (other than greenhouse gas emissions) were ignored, as were long term impacts such as reduced road infrastructure construction and maintenance. The results of this mode estimated the value of these short term, direct impacts at $712 million per year as shown in Table 9. [23]

TABLE 9: VALUE OF TRANSIT

Operating Cost Elements	(Millions $)
Increased travel time for current drivers	$113
Increased travel time for current trucks	$78
Operating costs of additional vehicles	$253
Additional parking costs downtown	$64
Increased net GHG emissions	$18
Increased collisions, injuries and fatalities	$62
Service for mobility challenged	$124
Total	**$712**

Even though this left out many items and used conservative assumptions, the value of transit is found to be 4.5 times the subsidy ($156 million) or 2.5 times the total annual operating cost ($281 million). This very conservative value indicates that public transit clearly provides more benefit than it costs [23]. However, in order to consider the appropriate level of subsidy, similar assessments would be required of other programs competing for limited public funds, and no such values are currently available.

3.3. Ongoing Changes

Edmonton Transit is currently undergoing a number of dramatic changes. These include updates to software used by dispatch and the control centres, adoption of new technologies such as SmartBus and strategic planning such as the transit strategy. In addition, ETS is working on several financial programs including smart fare, a low income pass and a fare strategy. [24]

3.3.1. Fare strategy

One criticism of the fare structure and financial status of Edmonton Transit mentioned in the Transit Review and Recent Audit of ETS is a lack of clear focus or strategy. Instead, the fare structure has evolved organically over time as a combination of initiatives that lack a documented cohesive reasoning behind which groups get discounts or the magnitude of those discounts. In addition, Edmonton Transit has no clear revenue or recovery targets. Without financial targets and a unified strategic goal administration is very limited in their ability to evaluate or improve the fare structure in a meaningful way. [24]

To address this issue, Edmonton Transit has committed to developing a fare strategy in the 2016 to 2018 business plan. This strategy will be informed by the current transit strategy and will develop a strategic document with clear principles and priorities. This will allow administration to determine the type of fare structure best suited for Edmonton, establish financial targets and provide methods for determining appropriate discounts for various groups. [24]

3.3.2. Smart Fare

Closely tied to the fare strategy is the smart fare initiative which will modernize fare collection and allow for a wider range of fare structure types. The goal of this initiative is to procure and deploy an account-based, open payment electronic fare system that will:

- Scale to accommodate the size and scope of the Capital Region
- Provide Edmonton Transit and its regional transit partners the ability to introduce innovative fare policy options.

The procurement process is currently underway and is scheduled to be completed by the end of this year with the contract award to the preferred Smart Fare Vendor. It is anticipated that the Smart Fare initiative will be implemented in two years following the selection of a preferred Smart Fare vendor. [24]

3.3.3. Regional Fare Integration

Edmonton and the Capital Region Board (CRB) are both aware of the need for improved fare integration between transit agencies in the Capital Region. Discussions are currently in the preliminary stages with a great number of details to be resolved. Such integration would likely result in some form of distance based regional fare structure, which would be difficult with prevalent use of cash fareboxes. Regional integration is one of the stated reasons for the Smart Fare initiative and so these two items will likely progress together. [24]

3.3.4. Low income pass

In order to better align the fare structure with the poverty elimination strategy, City Administration proposed a discounted monthly pass for individuals with low incomes in the 2016 operating budget. This discount would provide a targeted subsidy for those who are both the most dependent on transit and the least able to afford it. Providing this subsidy without reducing existing discounts would reduce fare revenue by approximately $6.4 million, which would result in either reduced service or additional subsidy. The City of Edmonton was initially unable to fund this initiative, although the Government of Alberta has since agreed to provide the missing funding.

3.3.5. Summary & Comments

While the types of subsidies offered by ETS are common, several observations are worth noting.

The first is the lack of discounted fares for those with greater need, such as single parents, individuals with moderate disabilities or individuals with low incomes. The only low income pass offered is an annual pass that is only available to seniors. The discounts offered to groups such as seniors, youth and students might be considered a proxy for a low income fare, as individuals in these categories often have limited incomes. However, this is a poor proxy as individuals in these groups may well be affluent and many individuals with low incomes are neither seniors nor students. When the low income pass becomes available, this issue will be partially resolved.

The second is the high level of subsidy for seniors' monthly and annual passes. Seniors discounts are very common; however the $14.50 is an unusually low price for a senior monthly pass. The CUTA average for seniors' monthly passes is $46.66, with most municipalities charging between $40 and $50. Many municipalities, including Calgary, Leduc, and St. Albert do not offer any discount on monthly passes to seniors. In the "Greater Edmonton" area, Strathcona County is the only other discounted monthly pass for seniors, and is nearly twice the ETS price ($28.00).

The third observation is the high apparent subsidy for U-Pass and monthly passes for both youth and adults. The cost of these three items ($121.5 million) account for nearly three quarters of the total subsidy provided by the City. This is surprising, as the ETS fares for these items are very similar to those offered by other municipalities.

4. Conclusion

4.1. Summary (Theory)

Throughout this paper, the various complicating factors related to transit fare rates and structures has been discussed. The price of a trip is dependent on the type of fare product used and discounts offered which collectively make up the "fare structure". Each fare structure is the result of conflicting objectives such as revenue generation, encouraging ridership and accomplishing various community goals.

Several types of fare structures are common, including those that reflect the distance traveled, the time period and the demographics of the individual passenger. Each of these provides flexibility to either better match the fare to the cost of providing the service, special needs of the passengers or other goals of the community. However, each also increases the complexity of the fare structure.

Each fare structure must be supported by appropriate fare collection and control systems to ensure efficient operation and compliance. Such systems can include turnstiles and gates at stations, on-vehicle payment methods, or occasional inspection by a conductor or peace officer, with each having both advantages and drawbacks.

Transit service requires a large amount of funding to operate, which can either come from revenue or subsidies. The R/C ratio is a useful way to understand the relative values of these two sources. However, R/C values range from 100% to 0%, and no single value is always preferable. The recovery is instead the net result of many factors related to the population served, system operation and strategic goals of the agency as well as external forces such as road patterns and available subsidy funding.

4.2. Summary (Edmonton)

The fare structure used by Edmonton Transit provides 14 fare products which include cash fares, bulk purchase and various period passes. The structure is flat in terms of distance traveled and time of day, but does include discounts for seniors, youth, students, and persons with disabilities. This fare structure is similar to other CUTA agencies, although the heavy use of discounted fare products results in comparatively low revenue being generated. This low revenue is offset by cost effective service provided to results in a recovery of 45%, which is reasonable but lower than similar municipalities.

Over the past 10 years, the expanding coverage area and ridership have resulted in a 90% increase in passenger-kilometers, and total cost of providing transit service has increased by 113%. However, ridership has also increased and so the cost per passenger-trip has increased only 26% to approximately $3.18 in 2014. Over this time the cash fare has increased by 60%, however, the average fare paid has only increased by 20% due to increasing use of discounted fares and so the R/C ratio has declined by approximately 3%.

4.3. Concluding Remarks

Currently, Edmonton Transit lacks clear financial goals, or policy regarding how fares should be determined or what they are intended to accomplish. As a result, the current ETS fare structure does not appear to follow a coherent rationale or purpose. Furthermore, fare recovery is not keeping pace with the cost of providing service and so despite operational efficiency, recovery is slowly declining.

Both the Transit Review done in 2013-2014 and the recent audit report on ETS identified this lack of consistent fare and financial policy as a challenge for Edmonton Transit that must be resolved before deciding on a Smart Fare system. However, these reports also indicate this is part of the larger problem that currently there is no clear strategic vision defining the objectives and priorities of transit service in Edmonton. However through council supported initiatives such as the transit strategy, fare strategy and smart fare initiatives, ETS is working with Edmontonians to develop both an overarching transit strategy and a detailed fare strategy to meet the future needs of Edmonton.

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