Administrative Report 2006TD4364

Trolley System Costs (K. Krushell)

Recommendation:

That the May 5, 2006, Transportation Department report 2006TD4364 be received for information.

Report Summary

This report responds to questions related to the costs of operating the trolley bus system in Edmonton.

Previous Council/Committee Action

At the March 14, 2006, Transportation and Public Works Committee meeting, Councillor K. Krushell made the following inquiry:

"I would like the following information to be provided to the May 16, 2006, Transportation and Public Works Committee meeting.

1. What will the trolley system cost to operate and maintain between now and 2008?
2. Will there be a need for any capital dollars for the trolley system between now and 2008?
3. Please provide information on what City Council can expect costs to be in 2008, if we replace our existing trolley system with new trolley buses and upgraded infrastructure. Also, what sorts of costs would there be to expand the trolley system?"

Report

1. What will the trolley system cost to operate and maintain between now and 2008?

Edmonton Transit operates a trolley bus system composed of 127 kilometres of overhead electric wire powered by seven substations and supported by 4,852 poles.

ANALYSIS

General Remarks: The narrow focus of the questions limit the scope of the report. It is *not* a comparison of the long-term financial viability of diesel vs. trolley and cannot be used reliably as the basis for any policy change regarding trolley buses.

The figures are a list of cash expenditures and do not reflect the complete cost/revenue picture of trolley operations. Nor do they detail the costs and investment losses that would result from trolley abandonment, or the costs of operating equivalent diesel service.

Transit is intended to provide specific benefits: transportation, reduction of vehicular traffic, reduction of air pollution, etc. In providing transportation, transit earns revenue. Trolley buses operate a set of busy routes serving core areas of the city and are relatively high revenue earners, thereby covering "additional expenditures" associated with their operation. In response to Mayor Mandel's enquiries on the 2006 budget, for instance, it was revealed that trolley Route 5 has a 106% cost recovery.

A life cycle cost analysis is required to determine the value of making long-term investments in any transit mode, including trolley buses. Trolleys and diesels have differing capital needs, different maintenance requirements and fuel costs, different life spans, different ridership/revenue levels and, in this case, they operate in different environments (i.e. trolleys in demanding stop-and-go traffic in the urban core, diesels often in lighter duty suburban and express work). **To date, no comprehensive life cycle cost analysis has been conducted with regard to trolley or diesel buses in Edmonton.** The 2004 Booz, Allen consultant's study was *not* a comprehensive life cycle cost analysis, as it compared 21 year-old trolleys to new diesels and ignored differences in operating conditions, passenger loads, etc.

The capital expenditures in this report indicate the trolley system is approaching a point of renewal. Just as the city has been investing in new diesel buses, investments are needed to purchase new trolley vehicles and upgrade the overhead infrastructure. **Capital upgrades can use federal/provincial infrastructure dollars and do not require local tax dollars; dismantling the system would be a local taxpayer expense.**

Capital items are investments with long-term value; they contribute to the value of the trolley system as an asset. After making these investments, the annual capital outlay to continue trolley operations drops to ~$500,000 annually after 2011 (refer to Table 3 of report). **Scrapping the trolley system would entail an expenditure of over $35 million, not a savings, and a loss of over $12 m in recent investments (see Figure 1).**

Rising operating costs due to rising diesel prices should be a concern. The media abounds with reports of how rising diesel costs have led to budget increases, shortfalls, service cuts, staff layoffs, fare hikes and closures in cities across the U.S. and Canada. **Oil prices have risen 200% in the past three years, while Alberta electricity pool prices show fluctuation within a relatively narrow margin of about 30% over the past five years** (see Figure 2). The *Canadian Centre for Sustainable*

A maximum of 37 trolley buses operate on seven routes, that is, the 3, 5, 7, 9, 120, 133 and 135.

To operate the trolley system, Edmonton Transit requires resources to fund specialized staff, materials and services unique to this fleet and overhead electrical system. The additional cost of operating and maintaining the trolley bus system for the three fiscal years, 2006, 2007 and 2008, is $7.2 million or about $2.4 million per year.

This amount is comprised of the following items:

a. $5.22 million in overhead electric wire network and substation maintenance arising from EPCOR services;

b. $390,000 as an operating hours premium of extra travel time required for trolleys to travel between the garages and their routes;

c. $540,000 in training costs for three days of trolley training for all new operators; and

d. $1.05 million maintenance costs from Mobile Equipment Services (MES) to cover extra staffing, and material and parts required for the trolley fleet.

2. Will there be a need for any capital dollars for the trolley system between now and 2008? The trolley bus system requires just over $7.09 million in additional capital expenditures over the three years of 2006, 2007 and 2008. This sum is comprised of the following items:

Transportation identifies a strong likelihood of gasoline/diesel prices climbing to ~$4.00/litre. In an environment of high oil prices, the trolley system is likely to be significantly cheaper to operate on core routes than diesel buses. **Records of the U.S. Federal Transit Administration already show trolley buses operate at less cost in U.S. cities** (see Figure 3); **Edmonton records offered to date are incomplete and do not allow this analysis.**

Cash flow figures do not assess trolley benefits such as air quality, particularly in the downtown core, and reduced noise levels. The number of trolley buses passing through core communities suggests replacement with diesel buses would result in significant negative impact. (See Figure 4) A quality downtown benefits everyone.

A research report from the U.S. Transportation Research Board (#1503, E.L. Tennyson, 1998) attributes ridership losses to discontinuation of trolley buses in U. S. cities as well as in Toronto. No savings materialized, but operating costs escalated. Trolley buses are known to attract and retain more riders than diesel buses, resulting in higher revenues. (See Figure 5) Such impacts are significant, but cannot be evaluated on the basis of the simple cash expenditure analysis presented in this report.

Comments on specifics in the report:

a. Administrative reports over the past two years regarding overhead wire maintenance costs are inconsistent and therefore potentially unreliable. To offer further comment, a breakdown of this and other recent figures is required. It is of note that wire maintenance is provided by Epcor, a city-owned utility which has returned a $120 million annual dividend to the city in recent years enabling funding of projects that could otherwise not be realized. This expenditure does not appear to disadvantage the city.

b. ETS operators' manual states trolleys travel <u>in revenue service</u> to and from the garage; there is no deadheading. Trolley routes are in relative proximity to garages and routing is fairly direct compared, for instance, to North Side diesel services dispatched from the Ferrier garage on the South Side. If these expenditures were significant, a prudent management would realize that additional wire to provide more direct access would pay for itself.

c. Only two garages operate trolleys. Why is it necessary to train all new operators on trolleys, and not just those operators who work out of trolley garages? Likewise, it is an unnecessary expense to train all operators on articulated diesel buses when only one garage operates them. A review of training policy is suggested.

d. This is a line item. It does not represent the comparative costs of maintaining diesel buses vs. trolley buses. These charges would appear as diesel or other costs if trolleys were abandoned, and a cost increase is likely. **Data in the Booz, Allen study shows that with similar use and age, trolley buses are significantly cheaper to maintain than diesel buses**. Diesels require refueling, oil changes, cooling system service, etc. In its lifetime, a diesel bus goes through several engines and transmissions. Cost of an engine and transmission runs about $40,000. Diesels require heated winter storage and costly garage ventilation systems due to noxious exhausts. Health impacts of diesel exhaust exposure contribute to lost time due to illness and increased health related costs of garage workers. By contrast, the motors in trolley buses typically outlast the chassis; they have none of the other maintenance issues. The inspection and changing of trolley shoes is minimal maintenance compared to diesel bus requirements.

a. $1.6 million in roadways projects to replace trolley poles during street rehab;

b. $2.2 million in trolley overhead projects to replace poles and upgrade intersections and substations. $1.5 million is funded in the Capital Priorities Plan (CPP) while $670,000 remains unfunded;

c. $1.5 million to refurbish several trolley buses over the period to keep them roadworthy until retirement; and

d. $1.79 million to fund the changes to accommodate South LRT crossing the trolley overhead, such as at 76 Avenue and at 111 Street at Southgate.

3. Please provide information on what City Council can expect costs to be in 2008, if we replace our existing trolley system with new trolley buses and upgraded infrastructure. Also, what sorts of costs would there be to expand the trolley system?

Between 2009 and 2015, $58.8 million in capital expenditures (2006 dollars) are forecasted to be required to continue the trolley system at its current level. In addition, annual operating costs of about $2.4 million will be incurred each year. The capital expenditures are comprised of the following items:

a. $35,280,000 to purchase 49 new trolley buses in 2010. This is an unfunded capital item which is the difference in price between buying 49 diesel buses at $400,000 each and 49 trolley buses at $1,120,000 each;

a. These are not true trolley costs. Expenditures for relocation of bus stops, shelters, street signs, lighting, trolley overhead and other street infrastructure incurred in roadways construction are properly accounted for as roadways costs. **How many other roadways costs are being attributed to transit in the accounting system?** (see 2d below)

b. 80% of poles also support street lighting, traffic lights, signage and cables for other purposes, so their replacement is not entirely a cost of trolley operations. In general, it can be observed that trolley poles are in better condition than standard streetlamp poles in many parts of the city and that trolley poles have often outlasted regular streetlamp poles. Is there actually a capital saving here? Note upgrades can be covered with infrastructure funds. See 3c below for further comments on capital upgrades.

c. Expenditure quoted is inconsistent with previous information. Ten trolley buses were newly refurbished within the past year and two more are in the shops undergoing refurbishment. Refurbishing buses only to scrap them in less than a year would be fiscally irresponsible. Other recent capital investments include Rossdale Road, wire and pole upgrades, new substation. Were these items funded with federal/prov. infrastructure funds?

   2004 administrative report on trolleys suggests older diesel buses would need to be refurbished if trolleys were abandoned.

d. This is not a trolley cost: Expenditures for the demolition of properties, relocation of street lighting, bus stops, shelters and other infrastructure resulting from LRT expansion are LRT construction costs. (See comment for 2a above)

a. Optimal life of a new diesel bus is 10-12 years and, with mid-life refurbishment, maximum life expectancy is approximately 18 years; trolley buses have typically lasted 25-30 years. The longer economic life of trolley buses offsets the higher initial investment. Council has decided to cover vehicle purchases with infrastructure funds, so this investment does not require local tax dollars.

   Why is the purchase of new trolley buses listed as 'unfunded'? Diesel buses are purchased at the rate of 35/year. Why is the purchase of 49 new trolleys concentrated in one year?

b. $3,180,000 is required in roadway projects to replace trolley poles during street rehab;

c. $20,330,000 is required to upgrade the overhead wire and substation network of which $890,000 is contained in the funded category of the capital plan. The remaining $19,450,000 is unfunded.

To address question about the costs that would be required to expand the trolley system, it is estimated that each kilometre of trolley system expansion would cost about $1.2 million. This estimate assumes intersections, substation construction, overhead wire and poles but does not include the cost of vehicles which as noted are estimated at $1.12 million each. In addition, operating costs will be incurred each year to maintain the trolley system.

Background Information Attached

Tables 1, 2 and 3 – Trolley System Costs (below)

b. Are these not roadway maintenance costs? Expenditures for relocation of bus stops, shelters, street signs, lighting, trolley overhead and other street infrastructure incurred in roadways construction are properly accounted for as roadways costs.

c. In 1992, a comprehensive evaluation of the overhead wire network was completed by Epcor. Their report identified maintenance and capital investment requirements to the year 2012: Total capital upgrades for 2007-2012 estimated at $499,469.00 and total maintenance at $4,219,522.00 (1992 dollars). The need for such extensive work is not identified in their report before 2012 (see Figure 6). On whose evaluation is the $20 million requirement based? What specific upgrades does this consist of?

Note that capital upgrades and extensions can be funded using infrastructure funds, and that by the time extensive capital upgrades to the trolley system would be required, South LRT will have been completed. This implies availability of funds.

Extensions would increase operating efficiencies on the trolley system by distributing per unit maintenance costs for the overhead wire network over more service kms and by increasing the revenues earned. More electric service would offer benefits in the event of future petroleum price hikes.

Information appended: Figures 1 – 6 (p. 5, 6)

Attachment 1

Tables 1, 2 and 3 – Trolley System Costs

Table 1: Question 1 – Trolley System Operating Costs for 2006, 2007 and 2008

	2006	2007	2008	Total
Overhead electrical wire and sub station maintenance	$1,740,000	$1,740,000	$1,740,000	$5,220,000
Operating hours premium (Extra deadhead time for trolley buses to travel between their routes and the garage due to the need to follow overhead wire)	$130,000	$130,000	$130,000	$390,000
Operator training (three days of trolley training required for new operators (estimated number of recruits per year – 175 in 2006; 200 in 2007; and 225 in 2008)	$158,000	$180,000	$203,000	$541,000
Mobile Equipment Services (MES) maintenance support	$350,000	$350,000	$350,000	$1,050,000
Total operating costs	$2,378,000	$2,400,000	$2,423,000	$7,201,000

Table 2: Question 2 – Trolley System Capital Costs for 2006, 2007 and 2008

	2006	2007	2008	Total
Roadway projects funded (incremental cost to continue trolley operation) (xx-66-1020)	$135,000	$637,200	$830,400	$1,602,600
Trolley overhead wire rehab funded (includes intersection, 33 Poles, 360 SS transformer in 2006; 24 Poles in 2007; 33 Poles in 2008 (xx-66-1411)	$837,000	$289,000	$406,000	$1,532,000
Overhead capital unfunded (xx-66-1511)			$670,000	$670,000
Trolley bus rehabilitation (corrosion repairs, etc.)	$500,000	$500,000	$500,000	$1,500,000
SLRT impact – 76 Ave crossover (includes intersection and reconnect power and pantograph upgrade (funded in 05-66-1671 and xx-66-1280)		$287,800		$287,800
SLRT impact – 111 Street to Southgate			$1,500,000	$1,500,000
Total capital costs	$1,472,000	$1,714,000	$3,906,400	$7,092,400

Table 3: Question 3 Trolley System Capital Costs for 2009 to 2015

	2009	2010	2011	2012	2013	2014	2015	Total
49 trolley buses ($1.120 M/trolley vs $400K/diesel) (xx-66-1780)	$35,280,000							$35,280,000
Roadway projects funded (xx-66-1020)	$386,000	$1,240,000	$1,027,600	$348,000	$117,000	$62,000		$3,180,600
Overhead capital funded (xx-66-1411)	$427,000	$458,000						$885,000
Overhead capital unfunded 2009 + (xx-66-1511)	$670,000	$8,705,000	$7,973,000	$600,000	$500,000	$500,000	$500,000	$19,448,000
Total capital costs	$36,763,000	$10,403,000	$9,000,600	$948,000	$617,000	$562,000	$500,000	$58,793,600

Figure 1: Identifiable Losses and Near Term Expenditures with Trolley Abandonment

Capital losses:

a. Trolley system (valued at $89 m in 2006 Asset Inventory; 80% in good to fair condition)
including recent investments over $12 m per 2004 ETS Trolley Fact Sheet (new poles, intersections, substation, wire, Rossdale Road and other improvements)

b. 87 complete trolley buses, 49 of which are on the active roster and include
12 newly refurbished trolley coaches

Expenditures:

a. $15-20 m to dismantle wire system and modify streetscapes (estimated based on admin's 2004 estimate of $13 m plus inflation)

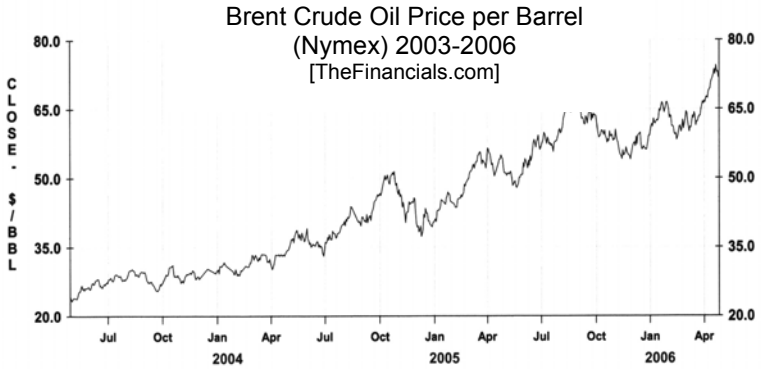
b. $? - Purchase of trolley overhead service equipment and parts from Epcor as required by contract (no figure provided by admin)

c. $? – Interim refurbishment of older diesel buses to continue service

d. $20-23 million to purchase replacement diesel buses

e. $? – Premium for diesel fuel over electricity and maintenance for diesel buses

Figure 2: Energy Price Trends



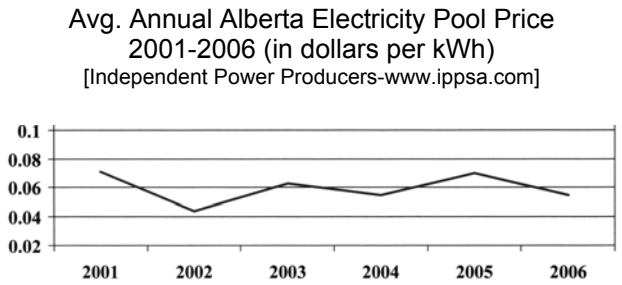


Figure 3:

U. S. BUS and TROLLEY COACH OPERATING COSTS COMPARED – 2003

DIESEL BUS	per Hour	COST ELEMENT	per Hour	TROLLEY COACH
$ 22,697,931	$ 4.96	Maintc of Way & Strctr	$ 8.18	$ 13,753,835
104,657,575	22.87	Maintenance of Vehicles	16.17	27,188,205
22,652,169	4.95	Fuel and Power	2.20	3,699,076
258,097,400	56.40	Conducting Transportat'n	54.68	91,938,841
15,284,501	3.34	Casualty and Liability	1.30	2,185,816
69,603,924	15.21	General & Administrative	17.26	29,020,929
$ 492,993,500	$ 107.73	TOTAL OPERATING COST	$ 99.79	$ 167,786,702
$ 138,038,180	$ 30.16	FARE REVENUE	$ 29.24	$ 49,161,503
	28.0 %	REVENUE to COST RATIO	29.3 %	
	add $ 4.30	Inflation in 2006 fuel cost	$ 0.20	
	add $ 1.03	Equalize Administrative Cost	- 1.02	
14.2 % more	$ 113.06	REAL COST DIFFERENCE	$ 98.97	save 12.5 %

Source: US Federal Transit Administration, National Transit Database for 2003. Table and notes compiled by E. Tennyson, Professional Engineer

Systems are Dayton, San Francisco and Boston.

Note: Much administrative cost is not assignable to a mode, so is allocated in proportion to miles, hours, costs or revenue. Trolley coaches do proportionally more work and are hit with a higher cost assignment. This is not properly attributable to the mode. To avoid this problem, it would be prudent and equitable to ignore system administrative cost and assign diesel buses $97.85 per hour and trolley coaches $81.71 per hour, a savings of 16.5%.

Figure 4: How many trolleys go by each day?

Location	Trolley passes per Weekday (per ETS 2004 schedules)
Downtown core	500+
Jasper & 101 Street	~ 465
124 Street & 107 Ave.	404
124 Street & 111 Ave.	318
107 Avenue & 101-123 Streets	200
107 Avenue & 156 Street	188+
118 (Alberta) Avenue	153
109 Street/Garneau	~101
102 Ave./Stony Plain Road	85
76 Avenue/Belgravia	70
65 Avenue/Parkallen	29

Figure 5a: Ridership loss on conversion to diesel

Akron, Ohio – 7%
Youngstown, Ohio – 9%
Denver – Loss reported, figure not specified
Toronto – Loss reported, figure not specified
Dayton, Ohio – 34% (despite 31% addition of service; trolley service later restored and extended)
San Francisco – 10-15% (trolley service later reinstated)
Arnhem, Netherlands – est. loss at 5% if trolleys were abandoned; trolley system was retained and expanded.

Sources: Tennyson (1998); Booz, Allen, Hamilton, (1991); Burmeister (1998). Dayton and San Francisco data refers to replacement of trolleys on certain routes, not system abandonment.

Figure 5b: Ridership gain on conversion to trolley

San Francisco – 10-15%
Seattle – 10%
Arnhem, Netherlands – 17%
Salzburg, Austria – 16%

Minimum increase of 5% cited in Tennyson (1998)

Sources: Booz, Allen, Hamilton, (1991); W. Teunissen, Oostnet (2005), G. Mackinger, Stadtbus (2005); Tennyson (1998).

Figure 6: Maintenance and Capital Costs for Edmonton Trolley System 1992-2012, per Edmonton Power, 1992
(in 1992 dollars)

TROLLEY SYSTEM COST
SUMMARY SHEET

APR. 1, 1992

MAINTENANCE ITEM	1992 COST	1993 COST	1994 COST	1995 COST	1996 COST	1997 TO 2001 COST	2002 TO 2006 COST	2007 TO 2012 COST	SECTION TOTALS
1. OVERHEAD CONTACT WIRE SYSTEM (SPECIAL WORKS)	$708,512	$684,176	$698,088	$682,091	$710,954	$3,381,923	$3,478,067	$3,665,983	$14,009,794
2. POLE MAINTENANCE	$23,000	$23,000	$23,000	$23,000	$23,000	$100,000	$100,000	$100,000	$415,000
3. FEEDER SYSTEM	$17,510	$17,510	$17,510	$17,510	$17,510	$47,525	$47,539	$47,539	$230,153
4. SUBSTATIONS	$81,320	$81,320	$81,320	$81,320	$81,320	$406,000	$406,000	$406,000	$1,624,600
SUBTOTAL	$830,342	$806,006	$819,918	$803,921	$832,784	$3,935,448	$4,031,606	$4,219,522	$16,279,547

CAPITAL REPLACEMENT ITEM	1992 COST	1993 COST	1994 COST	1995 COST	1996 COST	1997 TO 2001 COST	2002 TO 2006 COST	2007 TO 2012 COST	SECTION TOTALS
1. OVERHEAD CONTACT WIRE SYSTEM (SPECIAL WORKS)	$312,350	$209,935	$313,053	$674,095	$775,132	$1,452,211	$684,836	$0	$4,421,612
2. POLE REPLACEMENT	$649,968	$446,853	$454,239	$402,537	$480,090	$871,549	$369,300	$369,300	$4,043,836
3. FEEDER SYSTEM	$129,263	$157,837	$187,926	$187,205	$0	$53,135	$63,127	$130,169	$908,662
4. SUBSTATIONS OPTION #3	$387,013	$782,539	$332,664	$115,553	$115,553	$410,095	$0	$0	$2,143,417
SUBTOTAL	$1,478,594	$1,597,164	$1,287,882	$1,379,390	$1,370,775	$2,786,990	$1,117,263	$499,469	$11,517,527

GRAND TOTAL	$2,308,936	$2,403,170	$2,107,800	$2,183,311	$2,203,559	$6,722,438	$5,148,869	$4,718,991	$27,797,074