

Staff Report



To	Committee of the Whole
Service Area	Office of the Chief Administrative Officer
Date	Tuesday, September 17, 2024
Subject	Transit Electrification Audit

Recommendation

1. That the report titled Transit Electrification Audit dated September 17, 2024 be received.
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Executive Summary

Purpose of Report

To provide Council with the results of the Transit Electrification audit performed to assess the effectiveness, efficiency and economy of Transit Electrification and identify improvement opportunities.

Key Findings

1. The audit confirms that the steps taken to date are with due regard to the value for money principles. While we encourage the pathway to full electrification be continued, due to the increased costs of full-size buses and City budget constraints, consideration should be given to looking at alternate paths.
2. In conducting this transit electrification value for money audit, our primary objective was to ensure that the program has effectively utilized resources to achieve its intended outcomes, aligning with the principles of economy, efficiency and effectiveness as defined:
 - **Economy:** This focuses on optimizing the cost of resources used or required, considering the quality. It is about acquiring resources at the best price possible without compromising on quality.
 - For Guelph Transit and Fleet Services infrastructure this audit examined the financial expenditures, resource allocations and procedural adherence to assess whether the project has delivered optimal benefits relative to its costs to date. By scrutinizing budgetary controls, procurement processes and performance metrics, we aimed to identify any areas of potential overspending, inefficiencies or underperformance. Our comprehensive analysis was intended to provide actionable insights to enhance future project management practices relating to this project, ensuring maximum return on investment and sustainable value creation for stakeholders, as well as ensuring cost control and avoidance of future cost escalation.
 - By investing in the electrification of transit fleet/infrastructure the City has maximized the economic benefit of the Infrastructure Canada Investment Program (ICIP) funding by strategically aligning the investments with long-

term community and economic goals. The City has prioritized the transit electrification project as it also enhances infrastructure resilience, improves transportation efficiency, and supports sustainable development, ultimately driving broader economic growth and community well-being.

- **Efficiency:** This measures how well resources are used to achieve desired outputs. It is about maximizing output from given inputs or minimizing input to achieve a given output.
 - The work performed relating to Guelph Transit and Fleet Services infrastructure has demonstrably satisfied the value for money criteria of effectiveness and efficiency elements through its efficient allocation of resources, timely completion of milestones and outcomes achieved to date (For more details, see Appendix 1). By adhering to a well-structured approach, the project achieved significant results that align with the expected deliverables.
 - Stringent purchasing controls, in accordance with established procurement policies, were implemented to ensure fiscal responsibility and regulatory compliance. Each procurement request underwent thorough scrutiny, starting with a detailed requisition process that included clear specifications and budgetary constraints.
 - The best possible bus prices have been achieved through robust negotiation and procurement processes and ensuring that both the immediate financial benefits and long-term strategic goals are met, leading to optimal cost efficiency.
- **Effectiveness:** This assesses the extent to which objectives are achieved and the relationship between intended and actual impacts. It is about ensuring that the outputs produced achieve the desired outcomes and goals.
 - The Transit Electrification Program is directly aligned with the 'Be a leader in climate action' objective of the City's Strategic Plan's Environment theme and strongly supports both the corporate 100 per cent Renewable Energy (100RE) and the Community Net Zero Carbon targets. The City of Guelph 2022 Satisfaction Survey results showed that 90 per cent of those surveyed agreed that Guelph is an environmentally responsible city. The Pathways to Electrifying the Corporate Transportation Fleet review found that electrifying the fleet can help reduce greenhouse gas (GHG) emissions, energy consumption and costs. Transit buses were noted as the highest corporate GHG emitting fleet vehicle type, emphasizing the need for sustainable solutions in public transportation.
 - The new Guelph Transit and Fleet Services facility at the Watson-Stone site will employ sustainable design elements and strive to meet the Canadian Green Building Council (CaGBC) Zero Carbon Building – Design Standard. The Operations Facilities Long-Term Plan directly aligns with the Strategic Plan, enabling progress on strategic initiatives related to sustainability, community needs, transportation system efficiency and overall improvement of City operations.
 - The Canadian Urban Transit Research and Innovation Consortium (CUTRIC) analysis and the Zero Emission Bus (ZEB) simulation played a crucial role in impacting Guelph Transit's transition to electric buses. The analysis included evaluating the energy efficiencies of different electric bus configurations under various service and duty cycles. This assessment helped Guelph Transit

- understand the energy consumption patterns of electric buses compared to traditional diesel buses, aiding in decision-making for fleet electrification.
- The ZEB simulation provided estimations of electricity costs associated with operating electric buses, considering factors such as charging schedules and electricity billing structures. This cost analysis was essential for Guelph Transit to assess the financial implications of transitioning to electric buses. By simulating different electric bus configurations with depot and opportunity/on-route chargers, the report helped Guelph Transit understand the charging requirements and limitations of electric buses. This information was vital for planning the necessary charging infrastructure to support the transition to electric buses.
 - The Guelph Transit and Fleet Services Steering Committee, which has senior representatives from Finance, Transit, Operations, Environmental Services, Facilities and Energy Management, Project Management Office and Strategic Communications meets periodically to ensure timelines are adhered to and to ensure the new Guelph Transit Storage Facility offers substantial benefits relative to the investment made. This holistic approach underscores the project's commitment to delivering optimal value, ensuring overarching goals and providing long-term benefits for stakeholders.
3. Optimization measures have been identified and should be considered. These include (these are defined in detail further below in the report):
- Use of smaller lower-cost-per-unit electric buses for lower demand routes (**Economy**)
 - Extending the lifecycle of existing diesel buses before replacing these with an electric bus, to slow the pace of electrification during current unsettled electric bus market conditions (**Economy**)
 - The use of telematics. Telematics plays a crucial role in the efficient, safe and cost-effective operation of transit fleets and in contributing to sustainability goals. Its absence can lead to operational inefficiencies, higher costs and reduced service quality. Data-driven decision-making is crucial for optimizing operations and improving service quality as it will allow Transit Operations to base their strategies and actions on factual insights rather than on assumptions or guesswork (**Effectiveness**)
 - The role of a subject matter expert. There are risks associated with not having an Electrification Specialist or subject matter expert position in place within the organization. Risks include lack of coordination between departments, challenges to overcome with this new quickly changing technology, inadequate planning, potential compliance issues including maximizing governmental funding opportunities, poor stakeholder engagement and insufficient staff training. The Guelph Transit and Fleet Services Facility Steering Committee should decide upon the scope and responsibilities of the role and decide whether these requirements could be fulfilled by one or multiple roles that current exist within the current budget allotment (**Efficiency and Effectiveness**)

Strategic Plan Alignment

The recommendations identified are designed to close control gaps, strengthen processes and improve the internal control environment related to the Transit Electrification program. The audit supports the objective of 'Maintain the City's healthy financial position' objective under the 'Foundations' theme.

Future Guelph Theme

Foundations

Future Guelph Objectives

Foundations: Maintain the City's healthy financial position

Financial Implications

The audit recommendations should lead to a more effective control environment over the transit electrification program as well as a more effective and efficient approach to the full fleet electrification pathway. There may be costs associated with implementing the recommendations.

Report

Background

Guelph Transit provides conventional bus routes, and specialized transit services to the citizens of Guelph. The conventional, university, express, special and bus charters provide service to approximately 7.1 million boardings per year. These public transit services are an essential service and are provided in accordance with provincial legislation such as the Highway Traffic Act, the Employment Standards Act and the Ontario Human Rights Code.

Fleet Services procures and maintains transit vehicles as well as all City fleet vehicles. Decisions made in this report may impact other vehicle electrification projects in future, i.e. all electric vehicles (EVs) within the City of Guelph (e.g., buses, solid waste packers, fire trucks, ice re-surfacers, ambulances, etc.).

Electrification of Transit in Ontario

Ontario is actively advancing the electrification of its public transit fleet, with several key projects and initiatives currently underway.

Metrolinx is leading a major initiative that includes a joint procurement contract for 12-metre battery electric buses, with 10 participating transit agencies such as Barrie, Belleville, Brantford, Kingston and Thunder Bay. Other agencies including Chatham-Kent, Cobourg, Collingwood, Windsor, Brampton and Toronto Transit Commission (TTC) have all taken steps to electrify their fleet.

The Independent Electricity System Operator (IESO) is investing in projects that explore how electric buses and subways can support the electricity grid by reducing peak demand and utilizing stored energy efficiently. This includes a \$14.6 million investment in pilot projects in Toronto.

These efforts are part of a broader strategy to reduce GHG emissions and create a sustainable, efficient public transit system in Ontario. The collaboration between transit agencies, government bodies, and private companies underscores the commitment to a greener future for public transportation.

Status of Electrification at the City of Guelph

The City is committed to the United Nations Race to Zero campaign and has set targets for the whole community to reduce carbon emissions including:

- Reduce community carbon emissions by 63 per cent against the 2018 baseline by 2030

- Work together to become a net zero carbon community by 2050

In 2018, Council approved a goal for The Corporation of the City of Guelph to achieve one hundred per cent of its energy needs through renewable sources by 2050 (100RE Strategy). This was further reinforced through Council approvals in 2019 to develop a funding strategy and through the Strategic Plan and performance framework approval in 2020.

The City is planning to electrify the transit bus fleet (subject to budget approval) as one of the most impactful ways to reach the 100RE goal and reduce GHG emissions in support of the Race to Zero campaign. The capital budget includes the procurement of electric buses as well as facility and charging infrastructure costs needed in the future. Currently, the City is conducting an electrification pilot project to help inform the long-term plan. It is acknowledged that the budget is being reviewed at the time of writing this report, and therefore the final approved budget may have an impact on the priorities listed here.

Continuing on the path of electrifying buses is a crucial initiative aimed at reducing carbon emissions and enhancing sustainable transport solutions. By transitioning to electric buses, the City can significantly mitigate air pollution and improve air quality for residents. This transition also aligns with broader environmental goals, contributing to global efforts to combat climate change. Moreover, electric buses offer operational advantages, such as lower maintenance costs and quieter operation, which can further enhance the overall efficiency and appeal of public transportation systems. Embracing this path requires strategic planning, investment in charging infrastructure, and stakeholder collaboration to ensure a seamless transition that benefits both the environment and the community at large.

Audit Objectives and Scope

The objectives of the review were to assess the extent of regard for economy, efficiency and effectiveness as it relates to electrification of the bus fleet and identify improvement opportunities. The audit:

1. Reviewed the technology and performance of the vehicles and determined if the infrastructure has been adequately assessed, including understanding the performance of the buses compared to the vendor-agreed contractual performance standards
2. Assessed industry capabilities of bus electrification goals including the capability to deliver buses over the short-term
3. Reviewed if City facilities will be ready in time for arrival of the buses with adequate capacity of charging infrastructure to support the electrified fleet. The availability and reliability of supply chains for charging infrastructure components was considered, factoring in any potential disruptions or delays
4. Evaluated financial considerations to fund the program on a long-term basis
5. Reviewed if the logistics and operations of the program are evaluated and employed appropriately to meet the needs of the fleet/service requirements, to deliver the services
6. Determined if the program governance and management is well-defined, so that the service can complete its activities with acceptable levels of quality, following best practices

The review covered the conventional transit bus fleet only and not any other vehicles owned or operated by the City. The mobility fleet was excluded from the review. Any future growth and expansion of the transit services was excluded from the review. Consideration of federal and provincial funding and the potential impact of changes to the program were considered. Non-electrification components of the infrastructure proposal were outside the scope of this review.

Audit Approach

The following approach was used to conduct the audit:

- To determine the effectiveness of the electrification pathway being taken by relevant departments supporting and addressing the City's applicable strategic goals and objectives, the audit team met with various Guelph Transit, Fleet Services, Facilities and Energy Management, Corporate Performance and Strategy and Finance staff as well as other user department staff, including operators and maintenance staff, and other stakeholders.
- The team completed a detailed review of documents and records to validate the processes and controls. Potential opportunities for improvement and accompanying recommendations are provided below.
- The audit team met with the management of respective departments to discuss preliminary findings and recommendations to ensure timely actions are developed to mitigate key risks.

Detailed Findings and Recommendations

Observation #1: Electrification of bus fleet and options evaluation

The City currently operates 86, 40-foot diesel transit buses. Nova Bus is the vendor for the City for diesel and electric buses. Nova Bus (based in Quebec) and New Flyer (based in Winnipeg) are the only 40-foot bus manufacturers in Canada. Nova Bus will be discontinuing their diesel bus line from 2024. There is speculation that bus manufacturing of hybrid buses will discontinue from mid-year 2025.

40-foot electric buses:

Since the decision was made to switch from diesel to electric buses, the City has ordered the following total buses from Nova Bus:

- 2021 – Ordered four, 40-foot electric buses – four delivered
- 2022 – Ordered seven, 40-foot electric buses - six delivered
- 2023 – Ordered eight, 40-foot electric buses - zero delivered

COVID created a lot of disturbances in the market in general. Unpredictable and unmanageable pressures such as rising inflation, supply chain disruptions and labour shortages have all eroded the profitability of existing transit bus contracts for the Vendor. Nova Bus is not the only manufacturer affected. According to Nova Bus, inflation fluctuations have led Nova Bus to build buses at a loss. Initial inflation provisions at bid are falling short of actual index values and as a result Nova Bus has asked for price increases on existing orders which amount to a 23 per cent increase for orders placed in 2021 to 2023. To date, the City has not agreed to the price increases on existing electric buses ordered. The price increase will affect all future orders placed.

New Flyer has orders for over 5,500 electric buses. Nova Bus has orders for over 2,500 electric buses. If the City placed any orders now, the delivery for these buses will be in 18 to 24 months time. Contractually, the City is not bound to pay the

2023 order increased prices requested by the vendor, however given the large demand and limited supply of electric buses, not paying the requested increased amounts could jeopardize future orders and affect the planned yearly bus replenishment cycles. It should be noted that all the City's 40-foot transit fleet is from Nova Bus. In future years, the vendor will be quoting new increased prices.

Smaller (20 and 28-foot) electric buses:

Audit discussions with Transit Operations and Fleet Services identified that smaller 20-foot and 28-foot buses may be an alternative option for routes that are either short or experience lower ridership (e.g., industrial routes) or where non-busy times of the day or week (e.g., weekends) are observed. However, as these were preliminary discussions, planning and testing needs to happen before a decision can be reached on deployment of these units. These buses are cheaper alternatives to 40-foot buses. A 20-foot bus costs approximately \$500 thousand and a 28-foot bus costs approximately \$900 thousand. The delivery time is comparable to the 40-foot buses and ranges from 12 to 18 months from the date of order. Some other municipalities in Canada are already using older versions of these smaller models. These buses would use the same plug-in chargers for battery charging at the depot as the 40-foot buses as the charging infrastructure was developed in accordance with Society of Automotive Engineers Standards (SAE).

Extending the life of diesel buses:

The current Nova diesel Low Floor Series (LFS) buses that the City uses for Transit are typically retired after 12 years in service as it is found that ongoing maintenance tends to exceed the cost of straight replacement. This is aligned with industry practice. Audit inquiries found that refurbishment could extend the life of these buses by an additional eight years, which will have a negative impact on the Race to Zero targets. Refurbishment would incur costs but may be a relatively lower cost alternative during the immediate-term high inflationary cost and supply chain pressures impacting the electric bus market. If the City decides to take this path due to increased cost of electric buses and monetary pressure, it will not be the only operator to do so. There are examples of other transit operators who have used their buses for up to 20 years. The estimated cost of refurbishing diesel buses is estimated to be \$350 thousand per bus and typically takes nine to 12 months to complete. The buses will have to be sent to an external vendor. The work would be awarded by tender.

Transit Bus Replacement Plan and cost of each option:

The existing (conventional) transit bus replacement plan was originally based on a budget replacement cost of \$1.35 million for each fully outfitted 40-foot Nova long-range electric bus. This would have resulted in a total capital cost of \$129.3 million (incorporating inflation) over the period from 2024 to 2035 with an annual replacement of seven buses at the end of their 12-year service life.

Transit Operations has confirmed they can accommodate six to 10 smaller capacity buses (shorter buses 20 feet to 30 feet) within some of their routes and potentially dual purpose these smaller buses in other operational areas, such as mobility routes, transit on-demand, charters/rentals, shuttle run/trade-offs and for driver training purposes.

The 2024-2035 transit (conventional) bus replacement plan with four different cost options has been considered. The cost of each option is summarized as follows:

Table 1: Transit Bus Replacement Cost Options

	Option 1	Option 2	Option 3	Option 4
	\$ m	\$ m	\$ m	\$ m
Baseline cost (all 40-foot electric buses at 2021 cost)	129.3	129.3	129.3	129.3
Cost Increase/(Decrease)	29.6	14.4	3.6	(38.0)
Total outlay	158.9	143.7	132.9	91.3

Option 1: Continue to replace seven diesel-powered buses each year as per the 12-year lifecycle replacement schedule at a budget estimate cost of \$1.6 million plus three per cent inflation each year thereafter (formerly budgeted \$1.35 million and a two per cent inflation rate). Over the 12-year capital budget forecast, this revised option would require a capital budget increase of \$29.6 million over the existing budgeted cost of \$129.3 million.

One of the risks associated with this option is that the inflation provision may not be sufficient to cover the cost in later years.

Option 2: Rebuild seven buses scheduled for replacement in 2024, extending the life cycle of these seven rebuilt buses, and adding in a mix of smaller-size buses in the years 2025 and 2026. This will result in a capital budget increase of \$14.4 million over the existing budgeted cost of \$129.3 million.

Whilst this option right-sizes the fleet, there is a risk that smaller buses will not have sufficient capacity to accommodate ridership growth.

Option 3: Same as Option 2, with the expansion of the diesel bus rebuild program to include two bus rebuilds instead of replacements for the years 2025 to 2028, and to replace seven 40-foot diesel buses with electric models per year thereafter. This will result in a capital budget increase of \$3.6 million over the existing budgeted cost of \$129.3 million.

Option 4: Same as Option 2, with the expansion of the rebuild program to the entire conventional bus fleet to extend the replacement life cycle of all 40-foot diesel buses to a minimum of 20 years. i.e., rebuild seven buses per year from 2027 to 2034 instead of replacing these. This will result in a capital budget decrease of \$38 million over the existing budgeted cost of \$129.3 million.

This option provides savings, however at the cost, or potential loss, of ICIP funding which is dependent on Transit converting its fleet to electric power per the agreed terms/scope of the current ICIP funding agreement. Further, it will delay achieving both the corporate 100RE and the Guelph's Race to Zero targets.

Other Considerations:

Depending on the chosen option for the fleet asset life cycle, there is a potential cost impact to the transit fleet maintenance operating budget. It should also be noted that it is anticipated that the 2024 transit fleet maintenance operating budget will be overspent due to already extended transit asset life cycles, that are compounded by other life cycle items such as significant delay in bus deliveries. In

addition, until on-route charging capability is added, electric buses are not a simple 1:1 replacement for more heavier demand/difficult routes (primarily due to the daily range comparison of a 700 km +/- diesel bus compared to a 250 km +/- electric bus range on a single charge). The exact value of the overspend was unavailable at the time of this audit.

The new Guelph Transit and Fleet Services facility is being planned/built to accommodate the expanding electric fleet rather than diesel buses and to centralize and provide fleet maintenance capabilities that currently does not exist at the existing 45 Municipal Street facility. Planning, design and construction for infrastructure operate at long timescales and are intended for the long term. There will be significant cost and schedule impacts to shift design objectives and pace of design and construction contracts.

- If the Guelph Transit and Fleet Services facility continues as planned:
 - The facility can be used to store refurbished diesel vehicles since the transit storage area is intended to be an open-walled structure. However, there is no provision for on-site diesel refueling. Diesel pumps will remain available at 170 Watson and the adjacent solid waste facility.
 - Provisions for future expansion of electrical infrastructure will be included, however, it will likely be more cost effective to install the majority of the electrical infrastructure at time of facility construction. Therefore, some electrical infrastructure may be underutilized at the facility. In addition, the electrical utility cannot reserve unused grid capacity indefinitely.
 - Charging equipment can potentially be phased in over time to match the pace of vehicle electrification.
- Regarding ICIP, there is a packed schedule of works with tight timelines for infrastructure and therefore there is a significant risk of losing this sizeable funding for the facility if delays or direction changes are made.

When evaluating this decision, it is crucial to consider not only the lifecycle financial impact but also a variety of other objectives and potential impacts. This comprehensive approach will involve assessing social and environmental implications, which can often be as significant as financial outcomes. For instance, the option might be financially viable but may not promote sustainability or align with corporate values and long-term strategic goals. By adopting a holistic perspective, the City can ensure that its decision supports broader objectives, such as social responsibility and environmental stewardship, ultimately contributing to sustainable and balanced growth.

Recommendation #1

It is recommended that the Guelph Transit and Fleet Services Steering Committee evaluate the proposed options and decide upon the best course of action that balances lifecycle cost considerations and strategic goals to present to Council for their approval (Economy).

Table 2: Management Action Plan, Recommendation 1

Number	Department /Division	Action Plan	Target Completion Date
1.1	Operations / Fleet Services	Fleet staff will confirm with Guelph Transit the bus type and quantity requirements and develop specifications and life cycle maintenance plans to meet Transit dept’s needs.	First Quarter (Q1) 2025

Observation #2: Telematics monitoring

Basic data on the utilization of the four buses that are in operation is captured on a test sheet each time the bus is sent out. The sheet captures data such as the name of the driver, the route the bus was used on, the time at start and end, the odometer reading at the start and end of the journey, the temperature outside and the state of charge at the beginning and end of the shift. This data is being manually entered into a spreadsheet to understand the routes the buses have been tested on and the maximum kilometres that the buses travelled on different routes. This information and the manual data-capturing process has limitations; meaningful data analytics is not currently being performed. Furthermore, for a growing electric fleet, this work must be done with the help of integrated telematics software/system.

Telematics encompasses global positioning system (GPS) technology, vehicle tracking systems, on-board diagnostics (energy management and battery health) and wireless communications to gather and analyze data. Telematics can support transit fleets and other service areas where vehicles are being used in several significant ways. Not having telematics for fleet operations can lead to several risks and weaknesses, including limited monitoring and diagnostics. Without telematics, it is difficult to monitor vehicle performance, battery health and real-time location, which are crucial for maintaining the efficiency and reliability of fleets. Telematics systems can provide real-time data on battery health, charge levels and energy consumption. This helps in optimizing charging schedules and ensuring the longevity of the battery. Continuous monitoring of the vehicle’s condition, including motors, brakes and other critical systems, can help in predictive maintenance and reduce downtime.

Telematics systems provide data on route optimization, energy consumption and charging needs. Without this data, it is challenging to manage routes efficiently and ensure that vehicles are operating optimally. Telematics can analyze routes and suggest the most energy-efficient paths, account for traffic conditions and topography and identify charging station locations. Real-time data on traffic and road conditions can help in swapping vehicles to avoid delays, reducing energy consumption and improving service reliability. By tracking the location and status of each vehicle, telematics can help in optimizing fleet deployment, ensuring that vehicles are used efficiently, and that no vehicle is over or underutilized.

Telematics can predict and prevent potential issues through predictive maintenance by analyzing data trends. Without this capability, maintenance may be reactive rather than proactive, leading to increased downtime and higher repair costs. Telematics can help schedule maintenance based on actual vehicle usage and condition rather than just time intervals, which can lead to cost savings and better vehicle performance.

By optimizing routes, maintenance and driver behavior, telematics can help reduce operational costs. Monitoring energy consumption and optimizing charging can lead to significant energy cost savings.

EVs energy consumption can vary based on driving patterns, routes and environmental conditions. Telematics helps in identifying and implementing best practices for energy efficiency, which is harder to achieve without this data. Telematics can monitor driver behavior, such as acceleration, braking and idling, which affects energy consumption. Training programs can be developed based on this data to encourage more efficient driving habits. Improved driver behavior can also enhance safety, reducing the risk of accidents and associated costs.

Regulatory compliance often requires detailed reporting on emissions, energy use and fleet performance. Telematics systems streamline data collection and reporting, which is cumbersome and less accurate without such systems. Although EVs do not produce tailpipe emissions, telematics can help monitor and report on the overall environmental impact of the fleet, including energy sources and consumption patterns. Detailed data on the fleet's operation can support sustainability reporting and help Transit meet environmental goals and regulatory requirements. The City will be able to better report its positive impact on GHG reductions and illustrate target achievement.

As the fleet grows, managing it without telematics can become increasingly complex. Scalability is a significant issue since manual tracking and management of many vehicles is impractical. Real-time data on vehicle locations and arrival times can improve customer service by providing accurate information to passengers. Without telematics, providing such real-time updates and maintaining high service levels is more difficult.

Data-driven decision-making is crucial for optimizing operations, reducing costs and improving service quality. Without telematics, the availability of actionable data is significantly reduced, leading to less informed decision-making.

This telematic system could be used on all EVs within the City of Guelph (buses, solid waste and fire trucks, ice re-surfacers, etc.) Ideally, this system will show bus location, battery state of charge, battery temperatures, battery temperature state of rise and faults or irregularities in operation systems. This system would send alarms and notifications for all required fields of interest as identified by the management. Ideally, these alarms and notifications will have programmable and set points so a proactive response can happen. These alarms and notifications will be sent out at different levels with different responses to identified staff at that level of alarm. This system will have multiple levels of users, fleet staff, operations dispatchers, supervisors and managers.

By leveraging telematics monitoring, Transit Operations and Fleet Services can significantly enhance their operational efficiency and effectiveness, reduce costs and improve overall service quality, leading to potentially substantial economic

benefits. Fleet Services has added the cost of a telematics system to its 2024 budget.

Recommendation #2

2.1: It is recommended that Guelph Fleet Maintenance further enhance its understanding of the organization’s fleet electrification needs, assess the options and make a decision on acquiring the appropriate telematics system for user requirements. Once the system has been selected, Transit needs should be addressed first. The system selected should be able to support all future fleet needs and not be limited to buses (Efficiency and Effectiveness).

2.2: The process of how the data is retrieved, analyzed and shared, should be developed and implemented to maximize the benefits of the telematics system (Efficiency and Effectiveness).

Table 3: Management Action Plan, Recommendation 2

Number	Department/ Division	Action Plan	Target Completion Date
2.1	Operations / Fleet Services	Operations/Fleet staff will work with internal departments to determine the unique HARDWARE needs of a telematics program. In terms of selecting a telematics program that will be used across the organization, the immediate focus will be Guelph Transit and then it will be used across the organization by different fleet users. Expansion of a corporate (centralized) telematics program within the Operations department would require creation of a new 'Telematic Coordinator' position.	Q1 2026
2.2	Operations / Fleet Services	Fleet staff will work with user departments to determine the unique SOFTWARE and DATA needs of a telematics program. Users shall be provided with the full data access needed to make user specific operational and equipment utilization decisions.	Third Quarter (Q3) 2026

Observation #3: Electrification Specialist

Currently, there is no dedicated position for an electrification overseer/expert/super user at the City. There are several critical aspects of Guelph Transit's transition to electric buses that may be negatively impacted without this position.

Electrification requires close coordination between multiple departments, including operations, revenue service, business operations, supervising, scheduling, planning, health and safety, training, maintenance, infrastructure and finance. Without a dedicated position, there may be a lack of communication and alignment, leading to delays and inefficiencies. An electrification lead would provide specialized knowledge of the technical aspects of electric transit systems. Without this expertise, the City may struggle to implement and maintain EV technology effectively, potentially leading to higher costs and operational issues.

Transitioning to EVs involves navigating various regulations and standards. The Electrification Specialist would ensure that the City complies with all relevant requirements, avoiding legal and financial penalties.

Transitioning to electric transit involves several risks, including technological, operational and financial. The Electrification Specialist would identify, assess and mitigate these risks to ensure a smooth transition. Staff need training to operate and maintain new EVs and infrastructure. Without an Electrification Specialist to oversee this training, there may be a knowledge gap, resulting in operational inefficiencies and increased maintenance issues.

The position would be responsible for overseeing planning requirements, requests for purchase, inspections, training for all related staff (e.g. transit, fire, police), infrastructure, improvements, new products and features, product implementation, advice/support planning and scheduling. The position would also serve as the EV Telematic superuser/subject matter expert who would oversee all the background programs, and identify set points for health checks, notifications, and alarms. The role would also help identify and build policies and standard operating procedures (SOPs) for vehicle and facility responses and work with first responders to develop fire safety plans. The position would be responsible for identifying best practices, operating systems for facilities, as well as on-demand charging options, route analysis, driver performance analysis with telematic systems and identifying training, areas to improve, etc. The position holder will stay up to date on all zero emission vehicle technology as it relates to the City of Guelph's Race to Zero emissions.

Overall, an Electrification Specialist can drive efficiencies, reduce costs, improve service reliability and enhance the sustainability of transit operations, providing significant benefits and ensuring the large-scale project stays on track.

A discussion needs to happen around where this position would sit, to determine whether this is a Transit Operations or Fleet Maintenance role, or if multiple positions may be required.

Recommendation #3

It is recommended that the Guelph Transit and Fleet Services Steering Committee decide where the role best fits, how to manage and staff it and what the scope, responsibilities and title of the role will be in order to best address the needs of the City in regard to the electrification of the fleet (Economy, Efficiency and Effectiveness).

Table 4: Management Action Plan, Recommendation 3

Number	Department /Division	Action Plan	Target Completion Date
3.1	Transit Operations	The Guelph Transit and Fleet Services Steering Committee will decide where the role best fits within the organization, how to manage and staff it and what the scope, responsibilities and title of the role will be in order to best address the needs of the City in regard to electrification of its fleet. It is anticipated that the role will start within Transit Operations and will focus on Guelph Transit. However, ultimately based on the work of the Steering Committee this could evolve into a corporate wide role, accommodating the needs of other department's fleet electrification plans.	Q3 2024

Observation #4: Risk of thermal event

The lithium-ion batteries used in electric buses can overheat due to manufacturing defects, physical damage, overcharging or thermal runaway. This overheating can lead to fires or explosions. Thermal runaway is a critical condition where an increase in temperature causes further temperature rises in a self-sustaining loop. It can lead to the rapid release of energy and a potentially catastrophic failure of the battery. If a thermal event occurs while the bus is in a charging station or parked in a depot, it can cause extensive damage to these facilities and potentially other vehicles.

The probability of a thermal event (such as a fire or overheating incident) in electric buses can vary based on numerous factors such as the manufacturer, battery technology, usage patterns, maintenance practices and the overall operating environment. The incidence of fires in EVs, including buses, is relatively rare but is still a concern due to the nature of lithium-ion batteries.

As this new technology progresses it has become apparent that a proactive response to the identification of issues is the best approach for risk mitigation. Having a telematic system to identify the concern early is important. The next step in risk mitigation (thermal event / fire prevention) is to have someone on the property, so that if an EV shows a warning code or alarm stating that a vehicle has a small irregularity, it can be moved to an identified isolation area and protocols can be followed instantly, proactively.

Having staff on site allows instant inspection of identified vehicles. It allows multiple vehicles to be moved and the identified vehicle to be quarantined early before it

becomes a bigger problem. Staff will then communicate with all levels of management, the vehicle’s original equipment manufacturers and/or first responders if required.

As buses can be on the road, parked in barns, mechanical garages, on hoists to be serviced by mechanics, most agencies have identified that the best person to monitor this is a mechanical/fleet staff.

Currently, the member of fleet/mechanical staff who carries the emergency phone and is also present at the City facility (lead hand or supervisor), is not scheduled for 13.5 hours a week (from 5:30am to 7pm on Saturdays). However, during this time there are members from Operations on site. The physical presence of staff on site is one of the risk mitigations of a thermal event. This new responsibility will need to be added to the members of staff on-site and they will also need to be provided with appropriate training with a protocol in place on how to deal with a thermal event. Monitoring electric fleet telematics and charging stations 24/7 is crucial to have real-time insights into vehicle charging status. This will allow for the early detection of issues with vehicles or charging stations. Malfunctioning charging equipment will be promptly addressed to prevent accidents or injuries.

Recommendation #4

4.1: Operations staff, with assistance from Transit Operations, should develop SOPs and guidelines for the risk of thermal events, which will be used to train the staff of both areas (Economy and Effectiveness).

4.2: It is recommended that staff from fleet maintenance / an on-call member of staff (holding the emergency phone) should be made aware of this added monitoring responsibility and should be trained in how to deal with a thermal event (Effectiveness).

4.3: It is recommended that Operations staff, available on Saturdays, in the absence of Facilities staff, should be made aware of this added monitoring responsibility and should be trained in how to deal with a thermal event (Effectiveness).

Table 5: Management Action Plan, Recommendation 4

Number	Department /Division	Action Plan	Target Completion Date
4.1	Transit Operations	The Ontario Public Transit Association (OPTA) thermal event task force is building the recommended SOP for zero emission buses. Transit will follow the best practices identified by the OPTA.	Q3 2025

Number	Department /Division	Action Plan	Target Completion Date
4.2	Operations / Fleet Services	The Fleet shift supervisors shall receive thermal event training.	Fourth Quarter (Q4) 2025 (dependent on completion of 4.1 above)
4.3	Operations / Corporate and Community Safety Division (CCSD)	Operations CCSD staff will monitor for thermal events 24/7 and alert Fire and others as needed. In addition, Transit Operations should be trained on how to deal with a thermal event.	Q4 2025 to align with best practices with OPTA

Observation #5: Electric battery charging failure alerts

The bulk of fleet charging is done overnight, when buses would otherwise be idle, with a few exceptions. As an added benefit, fleet operators begin the day with the equivalent of a "full tank", making dispatch schedules easier to manage. Buses are plugged in after their regular runs are completed and they are cleaned and washed. The buses can be charged in four to five hours. Audit inquiries found that non-charging incidents that occurred were due to technical faults; the charger failed to charge the bus overnight. These incidents came to light the following morning when the buses were scheduled for their routine service resulting in the bus being replaced with a diesel bus.

Not monitoring the electric transit fleet charging overnight or even during the day can lead to risks such as overcharging, equipment malfunction and lost opportunities for data collection on energy consumption patterns.

The EV chargers could be configured/set to send automated alerts/notifications as soon as an error occurs. Charging point alerts significantly increase the hardware uptime using instant email or text message notifications with EV monitoring alert systems. Quick troubleshooting reduces downtime and avoids any delays in the fleet. The alert management system report identifies timestamps and urgency.

Automated alerts would increase efficiency by streamlining processes and automatically notifying relevant parties of important events, reducing the need for manual monitoring and intervention. This would lead to faster response times and more efficient operations. It would also result in reduced downtime due to non-charging of batteries overnight leading to improved efficiency and effectiveness of operations. With the increase in electric buses over time, automated systems/alerts can easily scale to handle increased data and alert volumes without requiring proportional increases in staffing. This is cost-effective and supports Transit growth. It is acknowledged that the needs and costs will change in accordance with the change in operations moving forward due to newer technology and evolving needs and therefore this observation/recommendation may not remain applicable in future, and alternates will have to be considered to mitigate this risk.

Recommendation #5

It is recommended that EV chargers should be set to send automated alerts/notifications as soon as the error occurs to the person on call so that these are addressed as early as possible (Efficiency and Effectiveness).

Table 6: Management Action Plan, Recommendation 5

Number	Department/ Division	Action Plan	Target Completion Date
5.1	Facilities and Energy Management	Facilities and Energy Management staff shall work with a pilot charging equipment vendor to establish alarm notifications.	Q1 2025
5.2	Operations / Fleet Services	Fleet staff shall work with bus manufacturers to develop charging alarm notification technology.	Q1 2026

Observation #6: Ongoing operating impact of electric transit fleet

The financial impact of operating the electric buses is not known. The operating and maintenance costs are still being worked out and budgeted for on the assumption that the associated costs are equivalent to an entirely diesel transit fleet.

Transitioning to an electric transit fleet involves several costs specific to this technology. Not factoring in the impact of an electric transit fleet on a diesel fleet can have several downsides.

Comparative analysis is currently not taking place for comparing the costs of electric transit with traditional fuel-powered fleets. If this analysis was happening this would help the City assess the long-term benefits and drawbacks of transitioning to EVs.

Unanticipated costs related to maintaining a dual fleet may not be known. Financial planning helps to budget effectively, allocate resources efficiently and plan for future investments. Accurate cost data aids in making informed decisions about fleet management, such as whether to invest in more EVs, infrastructure upgrades or maintenance programs.

While electric buses generally have fewer moving parts than diesel buses, maintenance costs can be different. Diesel vehicles and EVs require different maintenance and expertise. Not coordinating the transition could lead to gaps in maintenance capabilities and staff training, reducing fleet efficiency and reliability.

Policies and market incentives designed for diesel vehicles might not align with the needs of electric fleets. This misalignment can slow the adoption of EVs and reduce the overall effectiveness of transit policies.

Understanding the cost of operating an electric transit fleet is essential for evaluating the economic viability of sustainable transportation options and meeting environmental targets.

Transparent cost data fosters accountability to taxpayers, passengers and stakeholders, ensuring that resources are used responsibly and effectively.

Recommendation #6

It is recommended that the budgeting and actuals monitoring should commence and continue for electric buses. Comparative analysis of costs of electric transit with traditional fuel-powered fleet should be performed to understand the long-term benefits and disadvantages of transitioning to EVs.

6.1: Operations Fleet Services to perform budgeting vs actuals monitoring for electric buses for operations costs (Economy and Effectiveness).

6.2: Fleet Maintenance to perform budgeting vs actuals monitoring for electric buses for maintenance costs (Economy and Effectiveness).

Table 7: Management Action Plan, Recommendation 6

Number	Department/ Division	Action Plan	Target Completion Date
6.1	Operations / Fleet Services	Fleet planning staff will report back on the budget to actuals costs to determine the operating costs of electric buses. Transit Operations will coordinate with Facilities and Energy Management on other costs such as electricity usage for the electric bus fleet. These cost estimates will then be applied into operating budgets.	Q1 2026
6.2	Operations / Fleet Services	Implementation of the Fleet module in CMMS (Maximo) System will provide the ability to track all associated fleet asset costs to track and monitor 'Total Cost of Ownership' (TCO) of each Transit bus and the component of each bus. Provide necessary Finance, IT and administrative support to effectively manage the FMIS and cost data.	Q2 2027

Observation #7: Program Governance

The Guelph Transit and Fleet Services Facility Steering Committee oversees the design and construction project of the new Guelph Transit and Fleet Services Facility. The committee has representatives from Finance, Transit, Operations, Environmental Services, Facilities and Energy Management, the Project Management Office and Strategic Communications. The Deputy Chief Administrative Officers (DCAOs) of Infrastructure, Development and Environment (IDE) and Public Services (PS) also sit on this committee. The committee meets bi-monthly, and the Program Manager provides updates to the members of the committee.

Audit work and review of the minutes of this committee showed that the focus of the proceedings is the new facility. The committee lacks overall oversight on the issue of electrification which also includes decisions relating to the future and procurement of electric buses.

Audit work identified that there is a general lack of direction when it comes to decisions relating to buses, whether it be extending the life of diesel buses, buying smaller electric buses or moving forward with the decision to buy the 40-foot electric buses at the new/inflated prices. There is a lack of coordination and communication between Transit—who operates these buses—and Operations and Fleet Maintenance—who procures and maintains these buses. The decision-making is reactive rather than proactive. The decisions are not getting the same attention and involvement from the various departments despite electric buses being a vital component of electrification. A lack of robust decision-making could result in important decisions being overlooked or delayed resulting in a direct impact on receiving the electric buses on time and service delivery.

It is essential for the success of the committees to have clearly defined roles and accountabilities. Lack of clarity and direction leads to role ambiguity, with discussions veering off-topic or decisions being delayed. Audit inquiries identified that the Terms of Reference (TORs) of the Guelph Transit and Fleet Services Steering Committee were available but were not signed and circulated to all members. A review of the TORs found that they included transit electrification. However, committee members were unaware that it was also the committee's function. A committee's TOR serves as a foundational document that outlines the scope, objectives and procedures of the committee. It clarifies roles, responsibilities, decision-making processes and expectations, thereby guiding the committee's operations.

Addressing the above weaknesses will provide rigor and robustness to the conduct of the committee. This will ensure that projects align with organizational goals and priorities, reducing waste on misaligned initiatives. Effective decision-making will be facilitated, encouraging timely and informed decisions, preventing costly delays and missteps. Ensuring that resources are allocated efficiently and effectively will maximize the returns on investments.

Recommendation #7

7.1: It is recommended that a lead person should be assigned to the electrification program at the City (infrastructure, transit fleet and grant funding). This lead person will be relying on the expertise of the senior managers present on the committee and will ensure the planning, execution and implementation of decisions takes place in a timely manner (Efficiency and Effectiveness).

7.2: TORs of the Guelph Transit and Fleet Services Steering Committee should be refreshed to include all elements of the electrification program and circulated to all members of the committee (Effectiveness).

7.3: Committee members should be made aware that Transit fleet electrification is part of the TORs of the Guelph Transit and Fleet Services Steering Committee, clearly setting the expectations and building accountabilities for members, as well as explaining some of the supporting roles (Effectiveness).

Table 8: Management Action Plan, Recommendation 7

Number	Department/ Division	Action Plan	Target Completion Date
7.1	Operations / Fleet Services	Based on direction from the steering committee a person will be assigned to this role.	Q2 2025
7.2	Facilities and Energy Management	TORs of the Guelph Transit and Fleet Services Steering Committee should be refreshed to include all elements of the electrification program and should be circulated to all members of the committee.	Q2 2025
7.3	Facilities and Energy Management	Committee members should be made aware that Transit fleet electrification is part of the TORs of the Guelph Transit and Fleet Services Steering Committee, clearly setting the expectations and building accountabilities for members, as well as explaining some of the supporting roles.	Q2 2025

Financial Implications

The audit recommendations should lead to a more effective control environment over the transit electrification program as well as a more effective and efficient approach to the full fleet electrification pathway. There may be costs associated with implementing the recommendations.

Consultations and Engagement

Findings and recommendations have been discussed and reviewed with the Executive Team, the Strategic Work and Tactics team, General Manager, Guelph Transit; General Manager, Operations and General Manager, Facilities and Energy Management.

Attachments

None.

Departmental Approval

None.

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Appendix 1

Items considered as part of the audit:

Pathways to Corporate Fleet Electrification

A review of the existing corporate policies that relate to fleet electrification 'Pathways to Corporate Fleet Electrification' was conducted and reported to Council on July 19, 2019. Based on the policy review, pathways to electrify the corporate fleet were defined. The review identified that approximately 62.3 per cent of corporate GHG emissions are due to the entire corporate fleet. The transit bus fleet is the highest GHG emitting group (both per vehicle and in total) and contributes the majority (68.6 per cent) of the total fleet GHG emissions. Key findings suggested that electrifying the fleet can be an effective means for the corporation to reduce GHG emissions, energy consumption and energy costs. The existing Watson Road Transit Garage needed significant electrical infrastructure upgrades to accommodate EV bus charging. Replacing the fleet with EVs should be transitioned on a life-cycle replacement basis. Fleet vehicle lifecycles indicate that by 2040, the corporate fleet can be transitioned to fully electric or hybrid vehicles where market-ready options exist. This target has direct alignment with the corporate [Renewable Energy Funding Strategy](#).

Canadian Urban Transit Research and Innovation Consortium (CUTRIC) Performance Verification Study

City staff worked with CUTRIC to conduct detailed modelling of the electrification of Guelph Transit's entire fleet. The purpose of this independent analysis of bus route modelling was to optimize the procurement of electric buses. The modelling utilized geographic information system (GIS), topographical and actual transit route and travel data as well as electric bus manufacturers' vehicle data to determine information such as bus fleet battery sizing and charging requirements. This information was critical for the electric bus fleet selection as well as the design of the electrical charging infrastructure at the transit storage facilities. CUTRIC had completed similar studies for the TTC, Edmonton Transit, Quebec City, London Transit and Grand River Transit.

City Operation Facilities Needs Assessment

A 'City Operation Facilities Needs Assessment' was completed and reported to Council on October 21, 2019, to seek their approval to proceed with planning and design for a consolidated City Operations Campus. This report provided information regarding the current state, capacity and functionality for several City operations facilities and presented recommendations to meet the City's current and future operational needs. To assist in finding a long-term solution, the City retained Sterling Rothesay Consulting to complete the initial phase of the Facilities Needs Assessment Study. Based on this detailed analysis, the consultant identified the City-owned land adjacent to the existing Solid Waste Resources site, which measures approximately 70 acres, as the most suitable site to create a centralized campus. The 2020 Capital Budget included funding for work to begin starting with site plan development as well as preliminary site work to prepare it for eventual

use. The budget also included funding for the design of the Transit Operations facility. This was partially supported by ICIP: Public Transit Stream funding.

City Operations Campus: Transit Electrification

A report was presented to the Committee of the Whole on September 8, 2020 to provide an update on planning for the City Operations Campus, specifically the transition of Guelph Transit to an electric fleet and to seek direction from Council to proceed with the initial (pilot) installation of charging equipment at the current transit facility. Staff initiated preliminary site assessments for the City Operations Campus site that will include the future electric Transit facility. These assessments consisted of natural heritage systems review, environmental impact studies and engineering servicing studies. A route analysis and transit fleet electrification review were conducted to determine the bus fleet battery sizing and charging requirements. Engineering design of upgrades for temporary electric bus charging at the existing transit facility indicated that moderate modifications can be made to the existing transit facility to accommodate up to four 150 kilowatt (kW) electric bus chargers. The installation of the four initial electric bus chargers enabled Guelph Transit to procure electric buses for the lifecycle replacement allotment. The initial electric bus allotment was used as a pilot study to further inform how the City scales up the Guelph Transit Electric Bus Fleet Transition program.

City Operations Campus – Business Case and Staging Plan

A detailed business case and staging plan for a City operations campus was presented to the Committee of the Whole on May 3, 2021. It recommended that the municipal-owned site located at the northwest corner of Watson Parkway South and Stone Road East be approved as the site for the future City Operations Campus. A new purpose-built facility will enable transit electrification and significantly reduce GHG emissions, which supports the Council direction for Guelph to be a Net Zero Carbon community by 2050. Staff proceeded with the planning and design of the future facilities consistent with the City Operations Campus Business Case and Staging Plan.

The ICIP is delivered through collaborative agreements with federal, provincial and municipal governments, and provides long-term and stable funding for infrastructure. The Public Transit Infrastructure (PTI) stream is one of five funding streams offered by the program. The objective of the PTI stream is to fund the new construction, expansion, improvement and rehabilitation of public transit infrastructure. This was identified as the opportunity to leverage the ICIP funding for the transit component of the plan and creates a significant financial benefit, reducing the overall tax-funded capital requirement and reducing the overall debt required. Through two application phases in 2019 and 2022, the City of Guelph was awarded a total of \$99.4 million which accounts for both the federal and provincial share of funding. ICIP funding is approved for the stated amount. Additional costs must be covered by the municipality.

The business case provided the alternatives assessment and three were considered i.e., rehabilitation and expansion, new decentralized facilities, and a centralized City

operations campus. Based on the evaluation, alternative three, a Centralized City Operations Campus, was deemed to be the most cost-effective. It provided the greatest social benefit and had the lowest risk exposure. The centralized campus further enables transit electrification by providing a new location for a purpose-built facility and will significantly reduce GHG emissions, a critical driver for achieving Council's goals for 100RE and net zero carbon by 2050.

Facility functional space and site area requirements for each service area were considered for the analysis. The analysis included costs associated with facility rehabilitation, site decommissioning, land acquisition, site preparation, construction and temporary space rental. Alternative three was the most cost-effective solution by at least \$25 million.

The alternatives were scored against social benefit and risk categories. Social benefit categories included organizational culture, performance, sustainability, accountability and well-being. It was suggested that a centralized operations campus will positively influence the City of Guelph's position as an employer of choice in our sector and strengthen the organization's ability to retain and attract high-performing employees and teams. This enhances the public service value chain whereby engaged staff deliver better public service. Risk categories included service delivery, employees, public, physical environment, reputation, financial and regulatory.

Operations Facilities Long-Term Plan Update

The Operations Facilities Long-Term Plan Update was presented to the Committee of the Whole on February 7, 2023. With a deeper understanding of the Watson-Stone site characteristics, a reconsideration of the plan for this site was required to incorporate the site design parameters and appropriately match the assigned operating services to the Watson-Stone site. It was determined that the space requirements and the electrical infrastructure needs are well-suited to effectively accommodate Guelph Transit and Fleet Services. A site plan concept was presented. With only Fleet Services and Guelph Transit being located at the Watson-Stone site, the Operations Facilities Long-Term Plan was developed to locate the remaining operating services by leveraging existing lands and repurposing/renewing facilities. This will ensure that operating needs are met for the efficient delivery of community services.

Site investigations including archaeology, traffic impact, hydrogeological, environmental impact are completed. Also, the preliminary overall site plan design is completed including grading and excess soils, stormwater management and utility infrastructure. The facility design stage is currently underway.