



# Pilot Project Results Report

**Project Name:**            **Electrifying Small Equipment**

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# Pilot Project Results REPORT

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## Background

The Public Works Department with the City of Ottawa conducted a pilot project of small handheld battery powered equipment between June and November of 2022. The basis of this pilot project stems from a motion approved by City Council on March 22, 2022, with two specific directions:

1. That the Public Works Department (PWD) commit to phasing out the use of gas-powered lawn and yard equipment when said equipment requires replacement and an electric alternative is available that meets operational needs within both city-owned and contracted services; and
2. That phasing-out activities begin as quickly as possible, starting with summer operations planning in Q1 2022 and report back to the Standing Committee on Environmental Protection, Water and Waste Management as part of a Departmental Green Equipment Plan in Q4 2022.

This motion outlined that most handheld lawn maintenance equipment uses a 2-stroke engine which emits more than 20 times the toxic and carcinogenic exhaust than a vehicle. Furthermore, these engine types operate at a noise level beyond 90 dB's which is deemed harmful to the human ear. Battery powered equipment will not emit any exhaust and it was expected to operate at much lower noise levels.

The motion also indicated that the National Capital Commission announced a ban of gas-powered small equipment (leaf blowers, line trimmers, hedge trimmers and small chainsaws) effective April 2023 and prompted City Council to inquire if the City of Ottawa could do the same.

### **Pilot Overview**

While Council directed staff to consider phasing out all gas-powered equipment in the department, consultations with operational staff and initial market assessments determined there was a lack of awareness and market availability of medium to large battery powered equipment available for commercial use (lawn mowers, ride-on lawn mowers ...).

In response to Council's direction, additional research and consultation took place simultaneously to this pilot regarding larger battery powered equipment and will form part of the Green Plan to be presented to Council in 2023.

It was then determined that small handheld electric equipment would be tested in Roads and Parking Services as well as Parks Maintenance and Forestry Services, the two service areas within PWD that predominantly use this type of equipment.

#### Parks Maintenance and Forestry Services Pilot

The project team determined that the pilot project for Parks Maintenance and Forestry Services would be conducted by Parks and Grounds Maintenance, as they have the largest inventory of small handheld gas-powered equipment and use the same equipment that the NCC has included in their electric equipment transition in 2023.

The pilot tested string trimmers, leaf blowers, hedge trimmers and small pruning chain saws. The pilot also took into consideration that to make a conclusive assessment of operational feasibility, multiple brands of equipment should be tested. Four brands of equipment were tested by four crews, three of which were rural and one of which was urban. The crews and locations were established to ensure the pilot was conducting testing with every operational reality in mind.

The pilot took place from June 27 to September 29. The pilot was delayed from its initial start date of June 1, 2022, because of the operational response that was required from the Derecho Storm in May of 2022. There is no analysis in testing in this period which is identified in the gaps section of this report.

#### Roads and Parking Services Pilot

The project team determined that the pilot project for Roads and Parking Services be conducted by Roads Services as Roads Services relies on gas-powered equipment for a portion of its operations where other units do not.

The pilot project intended to test road cut saws, leaf blowers and string trimmers. Again, a conclusive assessment required testing multiple brands. Five brands were selected by city staff recommendation that these brands were expected to be successful based on experience with these types of equipment.

Road cut saws were removed from the pilot as the equipment was revealed to only cut 5ft per battery and was deemed inadequate for the needs of the road's crews.

Supply chain issues did not allow significant testing to occur because much of the equipment did not arrive until the fall of 2022. Line trimmers were removed as well due to timing and roads crews switching work tasks in the fall. It was decided to focus testing on blowers only, and this was done with one crew that was responsible for cleaning the streets and sidewalks of the downtown ByWard market area. A reasonable testing period was not achieved to provide conclusive analysis. That said, some insight can be made from testing that took place between September 13, 2022 and November 21, 2022.

### Evaluation Overview and Objectives

1. The Pilot intended to determine if the available commercial battery powered equipment on the market is a suitable replacement (able to meet maintenance quality standards) for the gas-powered equipment currently being used in PWD.
2. The Pilot intended to determine if phasing out activities can begin immediately.

### Methodology

There were five criteria that were considered for both pilots:

1. **Market Assessment-** PWD has limited experience in battery powered equipment and a decision was made to test five brands to attempt to get a baseline understanding of technology and determine if any generalizations can be made of battery powered equipment. Staff completed a daily survey to capture their experience with each brand of equipment throughout the testing period. Having results for multiple brands allowed for a comparison between them and to determine what features or specifications were preferable for staff.
2. **Maintenance Quality Standards-** The daily survey captured data related to power of the equipment, battery life and general useability (ergonomic rating of weight, balance, vibration, and comfort) for each type of equipment and noted the conditions they were used in while crews completed their work to the current maintenance quality standards. Tailgate meetings and crew leader feedback were also used to capture any feedback that was not identified in the surveys.
  - A. **Battery charging requirements-** Testing done to capture charging times for each type of battery.
  - B. **Noise Levels-** A decibel meter was used to capture the noise levels of all equipment while in operation.
  - C. **Battery life-** Daily survey was used to record the number of batteries used for each task and the time spent using the equipment. Battery life was also measured by

- conducting baseline tests of the batteries at the beginning and end of the pilot to track any loss in capacity.
- D. **Daily Tasks-** Crews used the equipment to complete a wide range of daily tasks including trimming all grass in a park, trimming around trees, fence lines, thick ditches, pruning branches, blowing garbage when required. The mix of crews and different beats gave more comprehensive feedback on the performance of the equipment.
  - E. **Types of equipment-**Hand held leaf blowers, hedge trimmers, line trimmers and pruning chain saws were selected for testing as they are the most used types of handheld equipment in PWD. These also match what was banned by the NCC.
3. **Ability to transition to lifecycle-** Discussions with City subject matter experts provided details for lifecycle measurements of the gas-powered equipment used in PWD. This information provided the necessary insight for the decision to use equipment life cycle as a method for replacing gas-powered equipment with battery powered substitutes.
  4. **Electrical retrofit of facilities-**The facilities that housed the equipment overnight and facilitated charging had to be retrofitted to accommodate the charging demand of the batteries. Costs and work performed were recorded to provide an estimate for future electrical retrofits as required.

### Key Findings

Below is a summary of findings based on user feedback surveys, tailgate meetings, crew leader recommendations and the project team results validation meeting. Brand specific details have been removed for confidentiality reasons.

#### 1. Market Assessment

**Parks Pilot-** Two brands stood out as superior for the types of equipment tested in the pilot. Scoring similarly highest in power, battery life and general useability. One brand received mixed reviews but averaged as the third best option. The last brand was determined to be inadequate for the needs of the parks crews as it scored consistently the lowest in all categories and staff raised concerns that the equipment was not of commercial quality.

**Roads Pilot-** While this was limited due to supply delays results indicate a slight preference for three of the five brands due to general useability although all brands tested very similarly in these conditions. A longer test period with various locations and multiple crews would provide more data for an in-depth comparison.

**See Appendix for Pilot Results Summary tables**

#### 2. Maintenance Standards

- A. Battery charging requirements-** each brand of equipment has a different method for charging batteries. For example, the one battery charger was slower but charged multiple batteries at once whereas another charger only charged 1 battery at a time but did so much quicker.
- B. Noise levels-** For noise level we can consider a success measure reducing the noise level produced by the gas-powered equipment to an acceptable level for the human ear. According to two sources in Canada<sup>1</sup>, 85dB are harmful to human ears.

No equipment tested in the pilot had an operating noise level below 85db. Therefore, although much of the battery powered equipment tested is lower than their gas-powered counter parts, the levels are beyond what is safe for a human ear and will require the use of ear protection when in use.

Type Of Equipment	DB reading
Gas Stihl Line Trimmer	116.8
Gas Stihl Hedge Trimmer	119.1
Gas Stihl Blower BG 66 with noise reduction	102
Gas Stihl Blower BG 55 without noise reduction	111
Gas Stihl Road Saw	116
Gas Stihl Chain Saw	121.2
Battery Brand 3 Chain Saw	110
Battery Brand 3 Blower	113.6
Battery Brand 3 String Trimmer	99.7
Battery Brand 3 Pole Saw	104
Battery Brand 3 Hedge Trimmer	96.3
Battery Brand 2 String Trimmer	93.2
Battery Brand 2 Chain Saw	111.6
Battery Brand 2 Hedge Trimmer	95.5
Battery Brand 2 Blower	105.3
Battery Brand 4 Blower	109.1
Battery Brand 4 Trimmer	104.3
Battery Brand 4 Chain Saw	111.7
Battery Brand 1 Chain Saw	108.9
Battery Brand 1 Blower	91.2
Battery Brand 1 String Trimmer	93.7

<sup>1</sup> Ontario [Noise Guidelines](#) and [Harmful Noise Levels](#) in Alberta

Battery Brand 5 Blower (18v)	97.6
Battery Brand 5 String Trimmer (18v)	103.7
Battery Brand 1 Hedge Trimmer	95.8
Battery Brand 4 Hedge Trimmer	101
Battery Brand 5 - Power Broom Bristle	105.9
Battery Brand 5 - Power Broom Rubber	105.9
Battery Brand 5 String Trimmer (40v)	117.8
Battery Brand 5 Blower (40v)	110.5
Battery Brand 5 Hedge Trimmer	100.1
Battery Brand 5 Chainsaw	115.8
Battery Brand 5 Pole Saw	116.1
Battery Brand 5 Road Saw	118.4
Battery Brand 2 Road Saw	103.5
Battery Brand 3 Road Saw	127.1
Battery Brand 6 String Trimmer	109.8
Battery Brand 6 Blower	116.1

**C. Battery life-** This has been identified as the biggest issue with battery powered equipment. On average 1 battery only provides approximately 1 hour of continuous use. This creates a need for crews to carry multiple batteries for each piece of equipment to complete their daily tasks. The need for multiple batteries per piece of equipment creates several issues. An increased demand for electrical capacity to support charging demand and a greater amount of equipment to transport in vehicles.

**D. Daily Tasks-** Overall, the battery powered equipment was a good substitute for gas equipment, although it is not as powerful as gas equipment so tougher jobs (thick grass/weeds, wet conditions) take longer but there weren't any tasks that couldn't be done with the extra time and enough batteries. (Note: the pilot took place from June 27 to September 29 and to thoroughly measure operational feasibility, testing should be done for the entire spring summer and early fall seasons.)

### E. Types of equipment

- **Line Trimmers** are suitable for use in the Parks and Grounds Maintenance if there is an adequate supply of batteries and the capacity to keep them charged. Crews may require additional time to complete tasks in difficult conditions (thick or wet grass) and a method of carrying multiple batteries when used in larger parks. Ongoing testing could help quantify delays. (Note: Limited results as no data was captured during heavy growing season of the spring.)
- **Pruning Chain Saws** are suitable for use in the Parks and Grounds Maintenance. Best used for pruning smaller branches and are not practical for heavy duty cuts.

- **Hedge Trimmers** are suitable for use in the Parks and Grounds Maintenance as their performance was found to be very comparable to the gas-powered equivalent. The battery powered hedge trimmers are lighter and don't have exhaust so using the equipment over head is much easier.
- **Blowers** are not up to standard for full time use in the Parks and Grounds Maintenance. They are best used as a supplemental piece of equipment for parks crews to perform quick cleanups. Lack of power and battery life makes continued use difficult because they don't move debris as effectively and struggle with heavy or wet debris which makes the batteries drain even faster. Using these blowers continuously at full power will drain a battery in approximately 15-25 minutes. Improvements will be needed before a full replacement of gas-powered blowers should be considered.

From the Roads Services' perspective, the blowers are fine for cleaning light debris but struggle with wet or heavier debris. Roads Services is responsible for cleanup for several special events, such as Canada Day where transitioning to battery powered equipment would have a significant impact to operations. Multiple batteries would be required for each crew member at a significant cost.

3. **Ability to transition to lifecycle-** One of the main goals of the pilot was to discover if PWD can commit to phasing out the use of gas-powered lawn and yard equipment when said equipment requires replacement. Subject Matter Experts within the City's PWD explained that the current gas-powered equipment can be maintained easily and at low cost for many years. For example, some line trimmers can work well up to and exceeding 10 years. There is no set life cycle for this gas-powered equipment. Much of the gas-powered equipment is relatively new and in no need of replacement. For these reasons it was determined that transitioning gas-powered equipment to battery powered equipment based on life cycle is not a logical method. Instead transitioning should be done at a set point in time that will be decided by several factors such as budget, council desire to switch to electric and the charging capacities at specific City facilities.
4. **Electrical retrofit of facilities-** Electricians installed 2 Rhino Charging Boxes at each facility to create a temporary system that provided extra plugs for the battery chargers. It was noted that the facilities were at their electrical capacity while batteries were being charged overnight. Further adoption of battery equipment would require permanent plugs, and possibly new electrical panels to be installed at facilities to accommodate the electrical demand for charging batteries.

Price of the electrical work including the equipment at each facility is listed below.

Electrical work- Iber	\$4,729.75
Electrical work- Bloomfield	\$3,938.80
Electrical work- Trim	\$4,369.50

Additionally, each crew was provided a secure charging cabinet to store the chargers.

Charging cabinet 1	\$1,004.50
Charging cabinet 2	\$1,004.50
Charging cabinets 3, 4	\$1,859.31

Note: discount on cabinets 3, 4 due to purchasing 2 at a time. Supply issues and timing prevented the ability to purchase cabinets 1 and 2 at the same time.

### Limitations of the Results

1. The pilot took place from June 27 to September 29 however to thoroughly measure operational feasibility and the effectiveness of the equipment, testing should be done for the entire spring summer and early fall seasons.
2. It was noted that the battery powered equipment was able to complete all the daily tasks required by the crews. Wet or thick weeds/grass would require an additional pass. The pilot did not capture the additional time required to complete the tasks and therefore identifying whether additional FTEs are required to meet maintenance quality standards is not possible. Further testing would provide the opportunity to measure these delays and impacts.
3. Generalizations can be made about the need to make electrical retrofits to accommodate the charging demand at facilities. However, each facility is unique and would require an in-depth study by electrical professionals in consultation with operational staff and Facility Operations Services to determine what exactly would be required to accommodate the charging demand at each specific facility. Furthermore, the charging demands would also be dependent on the number of batteries required at each facility.
4. Operational limitations
  - a. Concerns were raised about the effectiveness of battery powered equipment during storm cleanup that may involve prolonged power outages like the Derecho of 2022. Battery life would have a significant impact on operations in situations where staff are working around the clock to respond to emergency operations. The pilot did not test any method of reducing this concern. Further planning would be required if wide-scale adoption of battery powered equipment is to occur.
  - b. The operational response required for the Derecho delayed the pilot start date and therefore did not reflect performance during the heavy growth period in May.
5. Market availability of battery powered equipment is unclear at this time. There were several delays in receiving specific batteries and chargers over the course of the pilot. Suppliers noted the war in Ukraine and the continued supply chain issues related to Covid-19 as reasons for delays. There is a concern for ongoing delays by the project team.

6. DB readings for all gas-powered equipment have not yet been captured. It is expected that all 2 stroke engines produce noise above the 85db safety threshold, but continued testing will record this data when winter operations have concluded.

### Recommendations

1. Further research and testing are recommended to test equipment in all growth conditions. A second pilot that begins in early spring and continues until crews transition to winter maintenance is recommended to better understand the performance capabilities of the battery powered equipment. Additional testing will also provide the opportunity to measure the delays associated with heavy/wet grass to adjust crews' daily tasks or crew composition to accommodate the delay. This will allow us to identify whether additional FTEs are required to meet maintenance quality standards.
2. Make a transition to battery equipment at a point in time vs. Lifecycle where it makes economic and environmental sense.
3. Electrical feasibility at each facility needs to be understood prior to purchasing equipment for crews at those facilities. It is recommended that a feasibility study be conducted by electrical engineers in consultation with operational staff and Facility Operations Services, to quantify specific requirements to properly charge batteries. Permanent wall plugs should be installed in an open-air caged area with wooden shelves instead of the temporary plug systems and charging cabinets that were used in the pilot.

### Conclusion

The pilot project demonstrated that small handheld battery powered equipment can be used rather than gas-powered equipment to perform most operations in Parks and Maintenance Services during the summer months. Additional testing with an extended test period will allow us to determine if the equipment is as effective during the spring growing season as that remains unknown at this time. The limited roads pilot was insufficient to draw major conclusions. Although valuable data was gathered, further testing of multiple equipment types over a longer period should be conducted.

The pilot project and consultations with staff concluded that phasing out gas-powered equipment should be done at a point in time rather than at equipment life cycle. Further testing and analysis should be conducted to effectively determine that point in time.

While the pilot project successfully tested equipment of various brands throughout the summer it did not capture data from the spring or fall. Furthermore, the pilot did not measure delays associated with using battery powered equipment vs gas-powered equipment. The end results have generalizations that need to be supported by fact and continued testing. Overall assessment is that the technology is available and has an impact on maintenance quality standards, but further testing is required to determine that impact.

## Appendix

### Parks Pilot Results Summary Table

Rating Systems Explained:

#### Please Rate the Power of the Equipment

(1-Awful, only works on extremely light work, 2-Poor, bogs down routinely, 3-Acceptable, Works well but strains on heavier use, 4-Good, Performs well under most situations, 5-Excellent, Works in every situation)

#### Please Rate the Power Duration of the Equipment

(1-Awful, Battery died much quicker than expected, 2-Poor, Battery died earlier than expected, 3-Acceptable, Battery lasted as I would have expected, 4-Good, Battery lasted a little longer than expected, 5-Excellent, Battery lasted far longer than expected)

	Brand 2	Brand 1	Brand 3	Brand 4
<b>Equipment: Line Trimmers</b>				
<b>Power rating 1-5:</b>	3	3.5	3	2
<b>Battery Life 1-5:</b>	3	3	2.5	2
<b>Battery Life Average in hours.</b>	1.16	1.23	1.13	0.7
<b>Weight:</b>	Good	Good	Fair	Poor
<b>Balance:</b>	Excellent	Good	Fair	Poor
<b>Vibration:</b>	Good	Good	Fair	Good
<b>Comfort:</b>	Good	Good	Good	Fair, sore wrists after extended use.
<b>Benefits:</b>	Easy to start for students with limited experience, easily adjustable handle. Reverse polarity is a nice feature, easy to load string	Quiet, good power	String loading is quick and easy	The equipment is quite user friendly, easy to operate and has very low decibel levels while in use

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	Brand 2	Brand 1	Brand 3	Brand 4
<b>Issues:</b>	Thick grass required second pass, would like a strap attachment	String usage in thick grass, battery life over extended use, random stoppages	Small string compartment needs to be refilled too often. Few instances of random temporary shutdown. Battery life not satisfactory, heavier than Brand 2, Throttle control is lacing, wide open or too slow.	Light shower caused issues with cutting power, small string compartment requires more frequent re-stringing. The equipment has no way to feather the throttle while in use, it takes too long to get the spin rate moving, which will cause damage while operating, the unit is too heavy with the battery installed, the string line is a pain to install when needed
<b>Tailgate/crew leader feedback:</b>	This is the better one ,with good battery life , strong power, very little vibration, light weight, good balance, easy to string, Works very well,		Better with the 12v battery vs the 8v	I would not recommend this brand of equipment to be utilized in the is environment, it will break and the cost to exchange batteries once they go will be astronomical. It is not suitable to work in wet environments. It is not a practical solution for future usage IMO.- Darryl Forbes
<b>Equipment: Blowers</b>				
<b>Brand</b>	<b>Brand 2</b>	<b>Brand 1</b>	<b>Brand 3</b>	<b>Brand 4</b>
<b>Power rating 1-5:</b>	3	4	3	3.5
<b>Battery Life 1-5:</b>	3	3	2.5	2
<b>Battery Life Average in hours.</b>	1	1.5	1	0.8
<b>Weight:</b>	Excellent	Good	Good	Good
<b>Balance:</b>	Good	Good	Fair	Fair
<b>Vibration:</b>	Good	Good	Good	Fair
<b>Comfort:</b>	Good	Good	Fair	Fair
<b>Benefits:</b>			Quiet	Light and easy to use
<b>Issues:</b>	battery life not great for extended use		Batteries drain very fast when constantly used.	Battery life drains quickly with extended use, comfort issues if using for more than a quick job

	Brand 2	Brand 1	Brand 3	Brand 4
<b>Tailgate/crew leader feedback:</b>	bucket of batteries got partially submerged this week by 1 inch while in back of truck bed. Batteries unaffected thus far.			The equipment just doesn't seem powerful enough to clean the desired area we need to clean when doing finishing work on pathways and such. The blower can't be operated very long without fatigue to the wrists.
<b>Equipment: Chain Saws</b>				
<b>Power rating 1-5:</b>	Not enough Data	5	3	2
<b>Battery Life 1-5:</b>		5	3	2
<b>Battery Life Average in hours.</b>		1	1	1
<b>Weight:</b>		Good	Good	Poor
<b>Balance:</b>		Excellent	Good	Fair
<b>Vibration:</b>		Excellent	Fair	Fair
<b>Comfort:</b>		Excellent	Good	Fair
<b>Benefits:</b>				The equipment is easy to maintain, quite easy to replace a chain and bar, with low noise reduction
<b>Issues:</b>			Poor quality Chain and bar, not up to standard.	Chainsaw Bar is very flimsy and chainsaw doesn't bite enough, they need to improve quality of the bar and chain
<b>Tailgate/crew leader feedback:</b>		various size branches 9-inches and smaller. I cut 7 pieces of beach hardwood 13inch across for 1 battery		The equipment is not built strong enough to handle a commercial environment, the bar vibrates while cutting.
<b>Equipment: Hedge Trimmers</b>				
<b>Brand</b>	<b>Brand 2</b>	<b>Brand 1</b>	<b>Brand 3</b>	<b>Brand 4</b>
<b>Power rating 1-5:</b>	Not enough Data	4	Not enough Data	3
<b>Battery Life 1-5:</b>		4		3
<b>Battery Life Average in hours.</b>		1.34		0.71
<b>Weight:</b>		Good		Good
<b>Balance:</b>		Fair		Good
<b>Vibration:</b>		Good		Fair
<b>Comfort:</b>		Good		Fair

	Brand 2	Brand 1	Brand 3	Brand 4
<b>Benefits:</b>				
<b>Issues:</b>				
<b>Tailgate/crew leader feedback:</b>				

### Roads Pilot Results Summary Table

Equipment: Blowers					
Brand	Brand 2	Brand 1	Brand 3	Brand 4	Brand 5
<b>Power rating 1-5:</b>	5	4	3	2	4
<b>Battery Life 1-5:</b>	1	3	3	2	2
<b>Battery Life Average in hours.</b>	1	1	1	1	1
<b>Weight:</b>	Good	Good	Good	Poor	Excellent
<b>Balance:</b>	Good	Poor	Good	Fair	Good
<b>Vibration:</b>	Good	Good	Good	Good	Good
<b>Comfort:</b>	Good	Good	Good	poor	Good
<b>Benefits:</b>	No need to carry gas cans.				
<b>Issues:</b>	limited battery life, especially when moving heavy debris.				
<b>Tailgate/crew leader feedback:</b>	<p>Overall the guys seemed to enjoy the electric blowers since they didn't have to carry gas cans with them all night. But there were some downsides to the new blowers. For the most part all the brands seemed to have a battery life of about an hour of use before needing to be switched. And that was with only doing light work with the blowers. If you were needing to run the blowers wide open to move larger heavy debris the batteries died in as little as 15-20 mins.</p> <p>The three brands everyone seemed to enjoy the most were the brand 3, 1 and 4. They enjoyed these mostly for fit in the hand and the balance of the weight of the unit. Again, they all were very similar in battery life and drain.</p> <p>As for a replacement for our gas blowers I am not sure they would be able to completely replace our gas blowers simply because when we do large events and there is a lot of heavy bulky garbage laying on the roads (i.e. Canada Day) you would most likely need way more batteries per person than would be feasibly possible. The cost for the batteries alone would be far and above the cost of the fuel the gas blowers would use that day.</p>				



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