SSAFE CASE STUDY REPORT

Lawn Care Equipment Case Study

Kendal: Longwood
Location: Kennett Square, PA
Date Submitted: 5/18/23
Who to Contact for More Information: info@ssafe.org
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Summary:
A study by residents of electric alternatives to gasoline-powered string trimmers led to the purchase of battery-powered equivalents, as well as battery-powered leaf blowers and, eventually, an autonomous battery-powered lawn mower.

Objective: Residents wanted noisy and polluting gasoline-powered lawn care equipment replaced by battery-powered models.

Project Description:
Through research and analysis, residents made the case for battery-powered string trimmers, which cost more than gas-powered equivalents but which cost far less to run.

Brief description/characterization of community/campus:

- Four communities on over 500 acres in total
- The two largest campuses have about 400 residents each, of which about 300 are in independent living
- Types of residences: duplexes, cottage clusters, apartments
- Non-profit
- Residents take an active role in important decisions

Applicability: This case study would apply to any campus with a significant landscaped area.

Methodology (Activities, Steps):

This project was initiated by a resident who was irritated by the noise of our gas-powered string trimmers and offended by their pollution. A working group was formed within the Energy Committee and researched the alternatives. The result of their work was a report that showed a 3.3-year payback period for a battery-powered string trimmer. This led the Facilities Department to buy two of the string trimmers, plus two battery-powered leaf blowers. Subsequently, they purchased an autonomous battery-powered lawn mower as well.

Funding Needed (Amount, Sources):
The selected model of battery-powered string trimmer cost $770 per unit, which the Facilities Department paid.

Involvement or Support of Community Administration:
The Facilities Department was consulted during the research process to learn about the existing gas-powered equipment and, at the end of the process, they made the recommended purchase. The research was carried out by residents, however.
Later, the Facilities Department also purchased an autonomous lawn mower on their own initiative.

Key Challenges:
Much of the lawn care work is done by contractors with their own equipment. Kendal at Longwood has minimal influence on their equipment choices.

Outcome (Results):
Switching some trimmers, leaf blowers, and a lawn mower to battery-powered models has been very positive. This is a case where money is being saved, pollution is being reduced, and noise is avoided. The workers like the electric equipment. (And unwanted geese are being frightened away by the lawn mower.)

Lessons Learned:
Perhaps it would have been good to reach out to our lawn care contractors and present the case for battery-powered equipment. Two years later, they are just beginning to try out this type of equipment.

Next Steps or Follow Up: We need more electric lawn mowers. Our first one is proving successful but it is a small one and can handle only 1.6 acres, a fraction of our mowed lawn. Then, we need to begin focusing on our vehicle fleet. We did an analysis of our buses, and electric buses are still extremely expensive and a financial case cannot be

made for them. But the pickup trucks that are now becoming available have attractive economics.

Resources:
Watch a recorded presentation of this case study by George Alexander from Kendal at Longwood on YouTube at this link: https://youtu.be/BpPjkx7W_sY

Photo of autonomous mower:

"Mo," our autonomous lawn mower.

Attached: The report of the String Trimmer Working Group.

The Case for Battery Powered Lawn Care Equipment for Kendal at Longwood
January 20, 2020

Summary

The String-Trimmer Working Group of the Kendal Energy Committee has analyzed the use of gasoline powered string trimmers and leaf blowers at Kendal at Longwood and concluded that transitioning to battery powered equipment would reduce greenhouse gas (carbon dioxide and hydrocarbons) emissions by more than 90%. In addition, it would significantly reduce the inhalation of gas fumes and particulates by operators, and noise to operators and residents alike.

An economic analysis indicates a pay-back of the increased capital costs of battery powered equipment in less than three and a half years, considering only the savings of fuel and energy costs; maintenance costs are expected to be significantly lower for battery powered equipment, further reducing this pay-back period.

The Working Group recommends the pilot testing of battery powered lawn care equipment and (assuming results as predicted herein) the replacement of all string trimmers and leaf blowers with battery powered equipment.

Background

The String-Trimmer Working Group was formed to examine the issue of gasoline powered lawn maintenance equipment in use by Kendal at Longwood to determine if battery powered equipment would be feasible, have a significant positive effect on our carbon footprint thru reduction of greenhouse gasses, and economically viable.

Members are George Alexander, Jim Craig, Charles Robertson, Doug Spencer and Fred Thompson, all Kendal residents.

The attached document String Trimmer/Leaf Blower Usage and Emissions at Kendal summarizes the information learned regarding current usage and practices.

Analysis

One of the working group members, with extensive experience using battery powered string trimmers, leaf blowers and chain saws, analyzed the operational impacts of string trimmers and leaf blowers at Kendal. These results are summarized in the attached Battery Powered String Trimmers, Projected Pollution and Operating Costs.

The emissions of carbon dioxide and hydrocarbons for the current fleet of string trimmers and leaf blowers owned and operated by Kendal and projected emissions of the fleet after conversion to battery powered equipment is summarized in Table 1.

Table 1. Emissions of Battery Powered versus Gasoline Powered String Trimmers and Leaf Blower for Kendal at Longwood

	Battery Powered	Gasoline Powered
String Trimmers (approx. 2200 hrs/yr)		
Carbon Dioxide	200 lbs/yr	3200 lbs/yr
Hydrocarbons	nil	44 lbs/yr
Leaf Blowers (approx. 450 hrs/yr)		
Carbon Dioxide	80 lbs/yr	1300 lbs/yr
Hydrocarbons	nil	18 lbs/yr
Total		
Carbon Dioxide	280 lbs/yr	4500 lbs/yr
Hydrocarbons	nil	62 lbs/yr

Although the battery powered equipment does not produce carbon dioxide directly, the above calculations include an estimate of the carbon dioxide that is produced in generating the electricity used to charge the batteries.

Currently, some 4500 lbs of carbon dioxide and 62 lbs of hydrocarbons are emitted per year. A reduction in carbon dioxide emissions of 94% is anticipated, with a greater reduction in hydrocarbons emissions.

While not specifically analyzed, a similar reduction in particulates emissions is anticipated. Reductions in hydrocarbon and particulates emissions would greatly benefit the health of the equipment operators.

Additionally, the quieter operation of battery powered equipment, over gasoline powered equipment, would benefit both operators and residents alike.

Economics

Battery powered equipment is more costly than gasoline powered equipment, but improvements in battery capacity, costs and weight have been improving over the years. An analysis of the comparative costs of a string-trimmer is presented in Table 2.

Table 2. Cost Comparison of a Battery Powered and a Gasoline Powered String Trimmer

	Battery Powered	Gasoline Powered
Purchase Cost	$770	$220
Electric/Gasoline Cost	$0.02/hr	$0.40/hr

Costs are based on a mid-line Echo gasoline powered trimmer as used by Kendal and a Stihl FSA130R battery powered trimmer with Stihl AP300 battery and charger.

The payback period for the more expensive battery powered trimmer is estimated at 1450 hours of operation. (770-220)/(0.40-0.02) Assuming 2200 hrs/yr for 5 units, or 440 hrs/yr per unit, payback is 3.3 years. (1450/440) Since the hourly costs above do not include the cost of oil (for gasoline powered units) nor maintenance costs, the payback period should be shorter than this calculated.

Similar results are expected when comparing leaf blowers.

Conclusions and Recommendations

The conversion of string trimmers and leaf blowers from the current gasoline powered units to battery powered units is expected to reduce greenhouse gas (carbon dioxide and hydrocarbons) and particulates emissions by more than 90%, while providing for quieter operations.

While the purchase cost of battery powered equipment is significantly higher than gasoline powered equipment, significantly reduced operating costs are expected to provide a pay back period of less than three and a half years.

It is recommended that Kendal at Longwood converts its lawn maintenance equipment to battery powered equipment, beginning with the purchase and test operation of a single unit. Assuming the results are as anticipated in this report, a complete transition to battery powered equipment should follow.

ATTACHMENTS

String Trimmer/Leaf Blower Usage and Emissions at Kendal

String Trimmers
Based on discussions with Alex Dowd in Maintenance, while Kendal owns 9 string trimmers, on average, 4 units run five days a week during the summer and 2-3 are used one day every other week during the rest of the year. This means a total of approximately 2200 hours/year, assuming 6 hours actual operation per day.

Five gallons of a 50:1 gasoline:oil mixture is used every 2-3 days during the summer, say 10 gallons per week. Total annual use then would be approximately 185 gallons per year.

Leaf Blowers
Leaf blowers are not used as much during the summer; only after string trimming a certain area, then they blow off the walkways. The gasoline consumption above includes the leaf blowers during this period. When the full-time staff is using the leaf blowers in the Fall for leaf clean-up, they use approximately 25 gallons per month for two to three months, say 75 gallons. (2-3 days/week, 8 hours/day)

Emissions
Total gasoline consumption is approximately 260 gallons per year. Assuming 96% combustion efficiency, then approximately 4500 (260x6x3x0.96) lbs of CO2 and 62 (260x6x0.04) lbs of Hydrocarbons are emitted per year.

Alex also told me that typically two or three units are down for repair and maintenance at any time. He feels that the fuel with ethanol is fouling spark plugs more often, the fuel filters are getting plugged and the air filters need to be changed more often. He is quite excited about the prospect of battery powered lawn equipment.

From Fred Thompson, October 10, 2019, updated January 16, 2020

Battery Powered String Trimmers. Projected Pollution and Operting Costs.

Using the Stihl Kombimotor system as an example, and the AR3000 battery backpack, trimmers would have an approximate 2 hour run time. Assuming something like 95% charging efficiency with the AR3000 1.25 kWh battery and Fred's estimated 2200 hours usage, that gives us roughly 1.26 MWhr of electric usage. Using the electric to CO2 conversion factor of .0007metric tons/kWhr that gives us approximately 200 pounds of CO2 per year.

That leads to about $63 of electricity per year contrasted to about $550 of gas at $3/gal - a savings of nearly $500 per year on "fuel" and using the information in Fred Thompson's document above, a reduction of about 4,300 lbs of CO2.

From Charles Robertson, Dec 11, 2019