Some Cost Questions Involving Battery-Powered vs. Gas-Powered Leaf Blowers that the Workbook Can Help Answer

These questions are investigated with respect to commercial landscape maintenance contractors, not with respect to DIY homeowners. All prices and costs are current, thus they do not reflect the expected continuing improvements and reductions in cost of batteries for this equipment.

This analysis addresses costs only. The analysis does not address the substantial human health, ecological, climate and quality-of-life benefits of battery-powered or corded electric blowers relative to gas-powered.

	Gas	Battery	Corded	Handheld	
What are the relative costs of gas and battery leaf blowers for moderately demanding commercial work? (Relatively powerful backpack blower for spring cleanup and fall leaf removal -- 12 weeks/yr, 5 days/week, 4 hrs blowing/day)	$810	$1,466	$882	Infeasible	Total annual cost/yr for one blower
What are the relative costs of gas and battery leaf blowers for routine commercial work -- 1x/week during growing season blow off lawn and hard surfaces? (Small backpack or maybe large handheld blower -- 32 mows/property per season, 26 weeks/yr, 5 days/week, 1 hr blowing/day)	$669	$427	Too costly	$318	Total annual cost/yr for one blower
Sensitivity analysis -- cost comparison for routine commercial work during growing season, but assume that contractor already has the gas-powered equipment in new condition (i.e., no capital cost for this eqpt) and must purchase battery-powered to switch. Also assume 1 more battery set is needed per battery-powered blower than in base case. **CONCLUSION: BATTERY-POWERED IS STILL LESS COSTLY THAN GAS-POWERED, THOUGH THE COST ADVANTAGE SHRINKS BY ABOUT 40%.**	$613	$473	Too costly	$374	Total annual cost/yr for one blower
What is the capital cost for a very small landscaper (2 blowers, owner + 1 helper) to switch over immediately from gas currently to battery?		$ 4,898			
What is the capital cost/yr for a medium sized landscaper (8 blowers, 2 crews) to make this switch over a period of three years?		$ 6,531			
What is the capital cost/yr for a large landscaper (40 blowers, 8 crews) to make this switch over a period of three years?		$ 32,653			

Note for reference: The Greener Side LLC has 7 blowers and 1-2 crews

Contractor Cost Comparisons: Gas-Powered vs. Battery Leaf Blowers

Case #1: Moderately demanding work -- relatively powerful commercial backpack blower to be used for spring cleanup and fall leaf removal. Or perhaps corded blower, but substantial logistical issues

Cost elements	Gas	Battery	Corded, if possible
Capital costs			
Cost of leafblower (w/o fuel or battery)	$ 470	$ 499	$ 65
Cost of one battery or one corded setup (100 ft cord, reel)		$ 750	$ 39
# of batteries needed/blower, or corded setups/blower	0	5.3	1
Cost of in-truck battery recharging station (TOO COSTLY FOR THIS CASE)	$ -	$ -	$ -
Total capital cost	$ 470	$ 4,499	$ 104
Annual total capital cost (simple amortization over useful life)	$ 118	$ 1,100	$ 61
Annual cost for fuel or electricity (corded assumed free)	$ 300	$ 5	$ -
Add'l annual labor cost: refill fuel or swap out/recharge batteries or manage cords	$ 318	$ 336	$ 806
Annual cost for equipment maintenance	$ 75	$ 25	$ 15
Total Annual Cost	**$ 810**	**$ 1,466**	**$ 882**

NOTE: This sheet includes cells that have been hidden from view in order to select only the key data for printing

Case #2: For routine blowing -- yard and hard surface cleaning during growing season, roughly weekly. Remove or spread grass trimmings, etc. -- Small backpack blower or maybe handheld

Cost elements	Gas	Battery	Battery - handheld
Capital costs			
Cost of leafblower (w/o fuel; w/battery set)	$ 280	$ 399	$ 329
Cost of additional battery set (2 batteries; 1 for handheld)		$ 366	$ 225
# of battery sets needed/blower	0	1	1
Cost of in-truck battery recharging station (TOO COSTLY FOR THIS CASE)	$ -	$ -	$ -
Total capital cost	$ 280	$ 399	$ 329
Annual total capital cost (simple amortization over useful life)	$ 56	$ 67	$ 55
Annual cost for fuel or electricity	$ 86	$ 1	$ 1
Add'l annual labor cost to refill fuel or swap out & recharge batteries	$ 478	$ 340	$ 243
Annual cost for equipment maintenance	$ 50	$ 20	$ 20
Total Annual Cost	**$ 669**	**$ 427**	**$ 318**

Cost comparison #2 for Case #2, Investment pay back:

	Upfront	Year 1	Year 2	Year 3
Gas powered:	$ 280	613	613	613
Battery powered (backpack):	$ 399	360	360	360
Difference:	$ (119)	$ 253	$ 253	$ 253
Pay back:	$ (119)	$ 134	$ 387	$ 640

Payback occurs in less than 1 year for backpack battery blower. Handheld cordless battery blower pays back even faster

Case #1 -- Blowers for moderately demanding commercial work

Case #1 Moderately demanding work: spring cleanup and fall leaf removal. Blower must handle moderate quantity of wet leaves, small branches, blowing amidst shrubbery and thick ground cover. May involve moving leaves before shredding or mulching. At least 20 Newtons blowing force assumed required from blower to perform this work.
Assumed blower usage: 4 weeks in spring and 8 weeks in fall, 1/2 hour/property, 4 hours/day and 5 days/week

	Gas	**Electric**
Example model (backpack)	Stihl BR 500	Oregon BL120VX
Power output		
Watts	2000	1400
Newtons	22	22
Horsepower	2.7	
Fuel capacity (oz) (128 oz/gal)	47.3	
Noise rating (dBA)	65	59
Weight (w/fuel or battery) (lbs)	24.5	34
Purchase cost of leafblower (w/o fuel or battery)	$ 470	$ 499
Assumed blower useful life (in years)	4	5
Hours of use per year		
# of properties/day	3	3
Average hours of use/day of use	4	4
Number of days/year in use	60	60
sub-total: hours of use per year:	240	240
Assumed maintenance cost/per year	$ 75	$ 25
Gas blower fuel issues		
Gas blower gas/oil fuel ratio	50:1	
Gallons of fuel/hour of running time	0.24	
Run time on one tank of fuel (hrs)	1.54	
Cost of gasoline, $/gallon	$ 2.70	
Cost of 2-cycle oil, $/oz	$ 1.00	
Effective cost of fuel, $/gallon	$ 5.21	
Fuel cost/hr of run time	$ 1.25	
# fuel refills needed per day of blower use	2.60	

Blower usage:	# mows per property/yr	weeks/yr	days/wk	hrs/day
demanding:		12	5	4
routine:	32	26	5	1

Labor Cost/hr.

Wage rate:	$ 16.00
Fully loaded:	$ 22.40

Oregon's 120V system is the only landscaping tool system for which LA's SCAQMD provides up to 60% cost-share grant for purchase as a pollution-reduction measure

Battery characteristics		
Example model that fits electric blower	Oregon BX975 (120 V, 9Ah)	
Capacity (watt-hrs)	972	Perhaps the largest capacity battery now on the market for a battery-powered leaf blower
Assumed efficiency when charging (output watt-hrs/input watt-hrs)	95%	
Battery kWh used per hour of running time	1.40	
kWh needed for recharge per hour of run time	1.47	
Run time before battery depleted (minutes)	45	
Electricity if from grid for battery recharge, cost per hour of blower run time	$ 0.02	
Cost of grid electricity, cents/kWh	15	
Number of batteries required to purchase per blower	5	Quite costly to purchase 5 batteries per blower as would be needed to cover 4 hrs blower use/day. 5 hrs to
Number of battery swaps required per day of blower use	5	charge a battery. Recharging spent batteries on truck while 1 battery is in use could cut # batteries needed, but
Assumed useful life of battery (yrs)	4	5 hr charging time would mean that only the earliest used batteries could be recharged and available for re-use
Cost of battery pack, $	$ 750	later in the day. Truck recharging would be very costly and the costs of doing this would outweigh the savings
Time to recharge a single battery (hrs)	5	from buying fewer batteries
Establish in-truck battery recharging station		
Assumed capital cost	$ 500	
Assumed useful life (yrs)	10	
Assumed annual operating/maintenance cost to recharge from truck	10	?? Assumed ratio of cost to generate electricity for recharging at truck vs. cost/Kwh from grid. HIGHLY UNCERTAIN. (Factor for gas or propane generator on truck might be 50)
Assumed labor requirements (minutes)		
Swap out depleted battery with charged battery from truck or residence	1	Per change
Take depleted batteries from truck to recharge at charging location, next day load recharged batteries in truck	10	Per day
Buy gas and oil as needed, mix and fill cans, put in truck as needed	30	Per week (About 1 1/2 gallons fuel used/day)
Start gas blower (adjust choke, pull cord, deal w/ occasional overheated blower)	1	Per property more than needed for starting BPLB
Refill gas blower when fuel runs out	2	Per refill

Case #1 -- Corded, plug-in blowers for moderately demanding commercial work

Case #1 Moderately demanding work: spring cleanup and fall leaf removal. Blower must handle moderate quantity of wet leaves, small branches, blowing amidst shrubbery and thick ground cover. May involve moving leaves before shredding or mulching. At least 20 Newtons blowing force assumed required from blower to perform this work.
Assumed blower usage: 4 weeks in spring and 8 weeks in fall, 1/2 hour/property, 4 hours/day and 5 days/week

A corded blower could perhaps be used for this purpose. However, in general, landscape maintenance contractors do not choose to use corded blowers because: 1) Issues involving availability, location and homeowner consent for contractor use of at-home outdoor outlets; 2) Prohibitively high cost of supplying sufficient amperage alternatively from an electrical source associated with the contractor's truck (e.g., generator, battery, solar charger, electric truck); 3) Logistical difficulties in managing a corded connection, including: cord fouling, moving from one outlet to another, avoiding cord damage to plantings, cutting cords with mowers and other equipment, unintentional unplugging, wet weather hazards; 4) Time costs of finding outlet, taking cord on reel off truck to outlet, plugging in, laying out cord, securing plug-ins, shifting to new outlet as necessary, re-reeling cord, returning cord reel to truck; 5) Reduced worker productivity/time costs involved in dragging cord around while blowing, in a manner that avoids fouling and damaging vegetation, and in a manner carefully coordinated with mowing and other activities on-site; and 6) The great majority of corded blowers do not provide sufficient power for moderately demanding work.

Nevertheless, corded blowers are generally quieter and more energy efficient than gas or electric cordless blowers. Despite the many reasons why landscapers would prefer not to use corded blowers, if quiet operation is needed, a corded blower will avoid the high costs of the several batteries that would be needed for cordless blowers. We judge -- and a rough analysis confirms that -- this savings on battery costs may perhaps outweigh the high fixed labor costs of using cordless blowers. In our rough analysis, the battery savings may be larger than the fixed costs of using a cordless blower when the contractor is on-site and blowing for a lengthy period (i.e, for our "moderately demanding" case) at that site, but will not outweigh the fixed costs when the contractor is on-site and blowing for a short period (e.g., for our "routine case" averaging 7.5 minutes blowing per site). Thus, we provide a full analysis (below) of corded blowers only for the moderately demanding case. For this analysis we select what appears to be the most powerful currently available corded blower.

	Corded Electric	**Gas**	**Electric**
Example model (backpack)	Toro PowerJet F700	Stihl BR 500	Oregon BL120VX
Power output			
Watts	1368	2000	1400
Newtons	?	22	22
Horsepower	0.73	2.7	
Noise rating (dBA)	≤70	65	59
Weight (w/fuel or battery) (lbs)	6.7+	24.5	36.5
Purchase cost of leafblower (w/o fuel or battery)	$ 65	$ 470	$ 499
Assumed blower useful life (in years)	3	4	5
Purchase cost of 100 ft, 14 guage cord + hand crank hose reel	$ 39		
Assumed cord useful life (in years)	1		
Hours of use per year			
# of properties/day	3	3	3
Average hours of use/day of use	4	4	4
Number of days/year in use	60	60	60
sub-total: hours of use per year:	240	240	240
Assumed maintenance cost/per year	$ 15	$ 75	$ 25

Blower usage:	# mows per property/yr	weeks/yr	days/wk	hrs/day
demanding:		12	5	4
routine:	32	26	5	1

Labor Cost/hr.	
Wage rate:	$ 16.00
Fully loaded:	$ 22.40

Assumed labor requirements (minutes)

Remove cord reel from truck, plug in and lay out cord	5	Per property
Assume move cord to different plug 1x	2	Per property
Reel up cord, put back in truck	5	Per property
Total	12	Per property

Additional worker productivity loss while corded blowing 2% Of total worker blowing time

Kwh needed for recharge per hour of run time 1.44

Case #2 -- Blowers for routine commercial work

Case #2 Routine work: average 1x/week cleaning of property after mowing during growing season (mid-April through mid-October). Blowing grass trimmings, a few leaves, dirt and other material off lawn, patio, driveway and walkways. 10 - 14 Newtons blowing force assumed required from blower to perform this work.
Assumed blower usage: 26 weeks per year, 1 hour/day and 5 days/week, 32 cuts/yr/property. Assume 8 properties/day, 7.5 minutes blowing at each. Backpack blower perhaps needed rather than handheld, to avoid operator fatigue over the work day, but handheld with good strap may be OK.

	Gas-backpack	Electric-backpack	Electric-handheld
Example model (backpack or handheld)	Stihl BR 200	Ryobi RY40440*	Ego LB580*
Power output			
Watts	800	?	?
Newtons	12	11	17*
Horsepower	1.07		
Fuel capacity (oz) (128 oz/gal)	35.5		
Noise rating (dBA)	70	59**	65
Weight (w/fuel or battery{s}) (lbs)	14.3	24.8	9.6
Purchase cost of leafblower (w/o fuel; w/1 or 2-battery set)	$ 280	$ 399	$ 329
Assumed blower useful life (in years)	5	6	6
Hours of use per year			
# of properties/day	8	8	8
Average hours of use/day of use	1	1	1
Number of days/year in use	130	130	130
sub-total: hours of use per year:	130	130	130
Assumed maintenance cost/per year	$ 50	$ 20	$ 20
Gas blower fuel issues			
Gas blower gas/oil fuel ratio	50:1		
Gallons of fuel/hour of running time	0.13		
Run time on one tank of fuel (hrs)	2.18		
Cost of gasoline, $/gallon	$ 2.70		
Cost of 2-cycle oil, $/oz	$ 1.00		
Effective cost of fuel, $/gallon	$ 5.21		
Fuel cost/hr of run time	$ 0.66		
# fuel refills needed per day of blower use	0.46		

* assumed mostly run on economy mode, some on high, no Turbo. Very high uncertainty in wattage estimate

* on high

** tested independently as "significantly higher" than claimed level

Ryobi: 21.2 lbs incl 1 battery as initially outfitted; 3.6 lbs for a 2d battery, which can be fitted into the second slot on blower for extended run time

Ryobi including two 40V batteries and charger. Ego including one 56V battery and charger.

Blower usage:	# mows per property/yr	weeks/yr	days/wk	hrs/day
demanding:		12	5	4
routine:	32	26	5	1

Labor Cost/hr.

Wage rate:	$ 16.00
Fully loaded:	$ 22.40

Battery characteristics	Ryobi 40 V, 5Ah	Ego 56V, 5Ah
Example model		
Capacity (watt-hrs)	180	252
Assumed efficiency when charging (stored watts/input watts)	95%	95%
Battery kWh used per hour of running time	0.31	0.25
kWh needed for recharge per hour of run time	0.33	0.27
Run time before battery set is depleted (minutes)	69	60
Electricity to recharge battery set, cost per hour of blower run time	$ 0.005	$ 0.004
Cost of electricity, cents/kWh	15	15
Number of battery sets required to purchase per blower	1	1
Number of battery swaps required per day of blower use	0	0
Assumed useful life of battery (yrs)	4	4
Cost of addl battery set and chargers (Ryobi 2, Ego 1), $	$ 366	$ 225
Time to recharge a single battery (hrs)	3.33	1.67
No need for in-truck battery recharging station; recharge batteries at home base	0	0
Assumed useful life (yrs)	10	10

Intermediate calc:		
swaps/day intermed	-0.13043	0
round up	-1	0
round down	0	0

3 yr warranty

Although best price found for Ego battery and charger was $324, buying a 56V Ego tool (blower, trimmer, mower, chain saw, edger, pole saw, snow blower) as a package with battery and charger costs roughly similar amount. Assume this reduces effective cost of battery and charger to $225

Assumed labor requirements (minutes)			
Swap out depleted battery set with charged set from truck	2	1	Per change
Take depleted batteries from truck to recharge at home base, next day load charged batteries in truck	7	5	Per day
Buy gas and oil as needed, mix and fill cans, put in truck as needed	10	10	Per week (About 1/4 gallon fuel used/day)
Start gas blower (adjust choke, pull cord, deal w/occasional overheated blower)	1	1	Per property more than for BPLB
Refill gas blower when fuel runs out	2	2	Per refill

CO_2 Emissions

Fuel/electricity consumption per hour of use

Blower type	Gas (gas/oil mixture): Gal	Battery: kWh	Corded: Kwh	Handheld: kWh	Car*, for comparison: Gal	* Assume 24 mpg for city driving at avg of 16 mph
Large, case #1	0.24	1.47	1.44			
Small/med case #2	0.13	0.33		0.27		
					1.5	
Emission factors:						
lbs CO2/gallon gas	19.6				19.6	Source: EIA
lbs CO2/mWh		930.6	930.6	930.6		Source: PEPCO for 2019
Result: lbs CO_2/hour of use						
Large, case #1	4.70	1.37	1.34			
Small/med case #2	2.49	0.31		0.25		
					29.40	

Conclusions: ratio of gas blower emissions/hr to that for various battery and corded blowers:

Large blowers	3.47
Small/med blowers	9.00

ratio of car emissions/hr to that for gas blowers:

Large blowers	6.25
Small/med blowers	11.81

Impact of Potential Battery Cost Reductions

Source of info on likely battery cost reductions: Bloomberg New Energy Finance, Dec. 3, 2019 (provided by George Schu). Quotes below:

Average market prices for battery packs ...
[were] $156/kWh in 2019

Prices are projected to fall to around $100/kWh by 2023

the path to achieving $100/kWh by 2024 looks promising,
even if there will undoubtedly be hiccups along the way

Assume that these projections for large LI-ion battery packs for electric vehicles and renewable storage are applicable also for small Li-ion battery packs for, e.g., leaf blowers

Assume these projections specifically refer to prices in mid-2019 ($156/kWh) and at end-of-year 2023 — 4.5 years duration

Figuring the annual rate of change in battery prices over this period:

$100 = $156 x Y^4.5 — What is Y?
ln(100) = ln(156) + 4.5 x lnY — ln(100): 4.60517 ln(156): 5.04986
-0.444685821 = 4.5*lnY
-0.098819071 = lnY
Y = 0.905906598
9.41% projected decline in battery price per year

Assumed change in leaf blower battery prices from current (early 2020) to early 2022 (assumed to be when the newest, least costly battery equipment is available for purchase to comply with ban on gas-powered blowers) will thus be:

2 years at 9.41% projected decline in battery price per year equals: 17.93% total decline in price
or: 82.07% price in early 2022 relative to current price

Revised cost comparisons assuming projected decline in battery prices

(be careful, the following tables are values, not formulas)

original tables, w/out battery price reduction

Case #1: Moderately demanding work -- relatively powerful commercial backpack blower to be used for spring cleanup

Cost elements	Gas	Battery	Corded, if possible
Capital costs			
Cost of leafblower (w/o fuel or battery)	$ 470	$ 499	$ 65
Cost of one battery or one corded setup (100 ft cord, reel)		$ 750	$ 39
# of batteries needed/blower, or corded setups/blower	0	5	1
Cost of in-truck battery recharging station (TOO COSTLY FOR THIS CASE)	$ -	$ -	$ -
Total capital cost	$ 470	$ 4,499	$ 104
Annual total capital cost (simple amortization over useful life)	$ 118	$ 1,100	$ 61
Annual cost for fuel or electricity (corded assumed free)	$ 300	$ 5	$ -
Add'l annual labor cost: refill fuel or swap out/recharge batteries or manage cords	$ 318	$ 336	$ 806
Annual cost for equipment maintenance	$ 75	$ 25	$ 15
Total Annual Cost	**$ 810**	**$ 1,466**	**$ 882**

Case #2: For routine blowing -- yard and hard surface cleaning during growing season, roughly weekly. Remove or

Cost elements	Gas	Battery	Battery - handheld
Capital costs			
Cost of leafblower (w/o fuel; w/battery set)	$ 280	$ 399	$ 329
Cost of additional battery set (2 batteries; 1 for handheld)		$ 366	$ 225
# of battery sets needed/blower	0	1	1
Cost of in-truck battery recharging station (TOO COSTLY FOR THIS CASE)	$ -	$ -	$ -
Total capital cost	$ 280	$ 399	$ 329
Annual total capital cost (simple amortization over useful life)	$ 56	$ 67	$ 55
Annual cost for fuel or electricity	$ 86	$ 1	$ 1
Add'l annual labor cost to refill fuel or swap out & recharge batteries	$ 478	$ 340	$ 243
Annual cost for equipment maintenance	$ 50	$ 20	$ 20
Total Annual Cost	**$ 669**	**$ 427**	**$ 318**

Revised tables, with battery cost reduction:

Case #1: Moderately demanding work -- relatively powerful commercial backpack blower to be used for spring cleanup

Cost elements	Gas	Battery	Corded, if possible
Capital costs			
Cost of leafblower (w/o fuel or battery)	$ 470	$ 499	$ 65
Cost of one battery or one corded setup (100 ft cord, reel)		$ 750	$ 39
# of batteries needed/blower, or corded setups/blower	0	5.3	1
Cost of in-truck battery recharging station (TOO COSTLY FOR THIS CASE)	$ -	$ -	$ -
Total capital cost	$ 470	$ 4,499	$ 104
Annual total capital cost - ORIGINAL (simple amortization over useful life)	$ 118	$ 1,100	$ 61
Annual total capital cost - WITH BATTERY PRICE REDUCTION	$ 118	$ 920	$ 61
Annual cost for fuel or electricity (corded assumed free)	$ 300	$ 5	$ -
Add'l annual labor cost: refill fuel or swap out/recharge batteries or manage cords	$ 318	$ 336	$ 806
Annual cost for equipment maintenance	$ 75	$ 25	$ 15
Total Annual Cost	**$ 810**	**$ 1,286**	**$ 882**

Oregon battery price declines from $750 now to $615. $135 price reduction/unit x 5.333 units spread over 4 yrs useful life
$180 reduction in annualized cost

Case #2: For routine blowing -- yard and hard surface cleaning during growing season, roughly weekly. Remove or

Cost elements	Gas	Battery	Battery - handheld
Capital costs			
Cost of leafblower (w/o fuel; w/battery set)	$ 280	$ 399	$ 329
Cost of additional battery set (2 batteries; 1 for handheld)		$ 366	$ 225
# of battery sets needed/blower	0	1	1
Cost of in-truck battery recharging station (TOO COSTLY FOR THIS CASE)	$ -	$ -	$ -
Total capital cost	$ 280	$ 399	$ 329
Annual total capital cost (simple amortization over useful life)	$ 56	$ 67	$ 55
Annual total capital cost - WITH BATTERY PRICE REDUCTION	$ 56	$ 55	$ 48
Annual cost for fuel or electricity	$ 86	$ 1	$ 1
Add'l annual labor cost to refill fuel or swap out & recharge batteries	$ 478	$ 340	$ 243
Annual cost for equipment maintenance	$ 50	$ 20	$ 20
Total Annual Cost	**$ 669**	**$ 415**	**$ 311**

Assume battery set accounts for 60% of tool + 2 battery set cost for battery blower, 40% of tool +1 battery cost for handheld blower.
Thus amortized battery cost reduction for battery blower is 60% x $399 x 19.93% / 4 yr useful life = $12
Thus amortized battery cost reduction for handheld blower is 40% x $329 x 19.93% / 4 yr useful life = $7

Results:

	w/price red'n	w/o price red'n	
For case #1, the battery option is this % more costly than gas-powered:	**37%**	**81%**	$1,466
For case #2, the battery option is this % less costly than gas-powered:	**38%**	**36%**	$427