



An Environmental Landscape Footprint (ELF™) for the City of Glendale, CA

I. INTRODUCTION

The City of Glendale, CA is working with the American Green Zone Alliance (AGZA) to transition maintenance of several municipal properties from gas-powered equipment to battery electric equipment, to the extent allowed by advanced battery technology and has met AGZA's criteria for certification as AGZA Certified Green Zones®. An AGZA Green Zone is a defined area of land on which all routine maintenance is performed with battery electric equipment and/or manual tools. The minimal requirement for an AGZA Certified Green Zone is the elimination of all two-stroke equipment for routine grounds maintenance. AGZA is a recognized certification agency in the area of zero emissions, low noise land care practices.

Quiet Communities, Inc, a national nonprofit organization, works with AGZA to quantify the impacts of maintaining land with gas-powered equipment and translating those impacts to their health and environmental consequences using ELF™ (Environmental Landscape Footprint) methodology.

This ELF quantifies toxic and carcinogenic emissions, greenhouse gas emissions, noise, and solid waste resulting from the City of Glendale's grounds maintenance operations.

II. TECHNOLOGY

Advances in battery technology have enabled the development of zero emissions, low noise battery electric equipment capable of performing at commercial levels. These advances have resulted in equipment that have run times, charge times, and performance that makes it practical and cost-effective when applied to all but the heaviest maintenance work. Currently, lithium battery technology has proven itself to be a comparable alternative to gas powered equipment for 100% of Routine commercial grounds maintenance and Special Tasks, like shrub and tree pruning:

- Mowing
- String/line trimming
- Hedge trimming
- Debris blowing
- Light to medium tree work

Areas in which gas-powered equipment is still needed include blowers for heavier clean-ups, and heavier equipment capable of dethatching, aeration, heavy tree trimming, rototilling compacted areas, heavy seasonal workloads and contracted enhancement work.

III. PROPERTY AND MAINTENANCE OVERVIEW

The following City of Glendale facilities were selected for transition to battery electric equipment:

- Verdugo Adobe: 1.3 acres
- City Hall Complex (no acreage information at this time)
- Route 1: 2.62 acres
 - Casa Adobe de San Rafael: 1.60 acres
 - Maryland Ave Park: .48 acres
 - Heritage Garden: .54 acres
- Route 2: 1.19 acres
 - Wilson Mini Park: .32 acres
 - Doran Mini Park: .58 acres
 - Harvard Mini Park: .29 acres

Exhibit 1

5.30 Total Acres (excluding City Hall grounds)

Non-diesel gas-powered maintenance equipment currently used by the City or its contractor(s) for Routine Maintenance tasks (regular mowing, clean-ups):

- Push mowers (e.g., Honda HRC216)
- String trimmers (e.g., Stihl FS110R)
- Backpack blowers (e.g., Echo PV580)
- Hedge trimmers (e.g., Echo HCA2620)

IV. METHODOLOGY



An inventory of gas-powered equipment being replaced by the City was conducted to estimate their impacts and of replacing them with battery electric equipment. The inventory involved identifying equipment by brand and model, documenting their frequency and duration of use in citywide grounds maintenance. The analysis included only gas-powered equipment for which commercial grade battery electric equipment are currently available and capable of matching the work productivity of gas equipment. Diesel powered equipment was not included.

Impacts included the following:

A. Toxic and Carcinogenic Exhaust

The exhaust emissions below were quantified in pounds-per-year using validated equations from the US Environmental Protection Agency.

- **Ozone-forming emissions: Non-methane hydrocarbons (HC)**, also known as volatile organic compounds, include benzene, 1,3 butadiene, formaldehyde, and acetaldehyde, all of which are potent carcinogens ([Loh, 2007](#)). Additionally, these compounds combine with **Nitrogen Oxides (NOx)** in warm season months to form ground level ozone, a cause of lung and heart disease.
- **Carbon monoxide (CO)** is a toxic gas which can harm health when people are in close proximity and which can accumulate in enclosed settings (sheds, trailers) and result in death.
- **Fine particulate matter (PM2.5)** is a cause of cancer, lung disease, heart disease, and premature death ([IARC, 2012](#); [US EPA](#)).

B. Greenhouse Gases

- **Carbon dioxide (CO2)** was quantified in pounds per year. CO2 is a major greenhouse gas that contributes to global warming and climate change.

V. EMISSIONS IMPACTS

A. Annual Toxic and Carcinogenic Exhaust Emissions

Gas-powered maintenance of Glendale properties selected for Green Zone Certification account for 5,883 pounds (2.9 tons) of toxic and carcinogenic exhaust each year. Contributions of specific exhaust components are in Table 1 below.

Exhibit 1

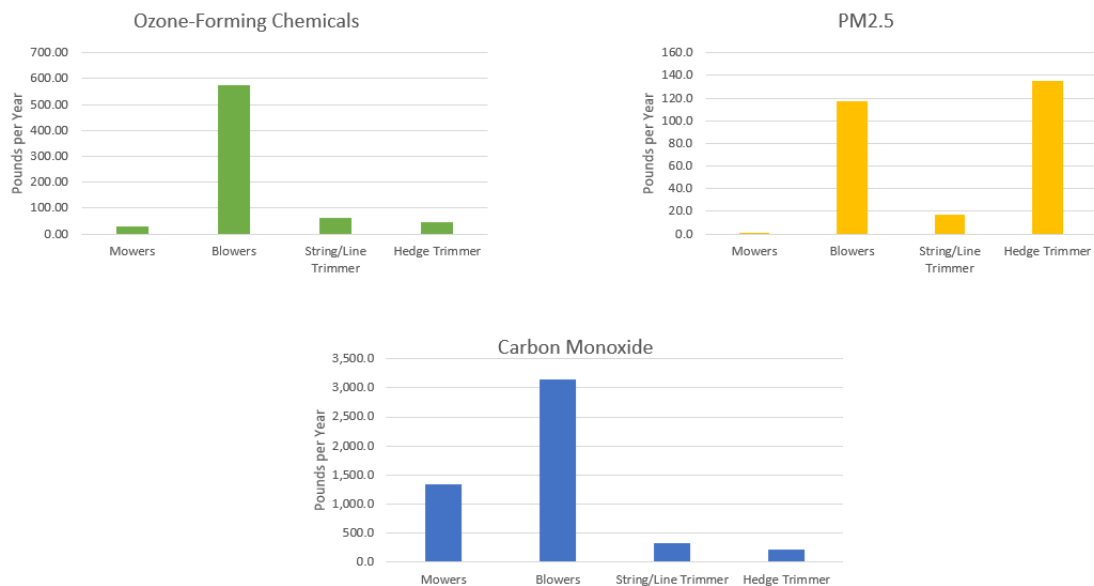
Table 1. Annual Toxic and Carcinogenic Emissions

Category	Impact of Gas Equipment
Ozone-forming exhaust	712 pounds
Carbon monoxide	5,024 pounds
Fine particulate matter	147 pounds

Note: The amount of each emission type is not indicative of toxicity or carcinogenicity. Rather, the potency or strength of the emission in causing disease must also be considered. As a hypothetical example, small amounts of PM2.5 may be more toxic than large amounts of ozone.

The amounts of toxic and carcinogenic exhaust emitted annually by tool type is shown in the Exhibit below.

Exhibit 1. Amounts of Toxic and Carcinogenic Exhaust by Type of Tool

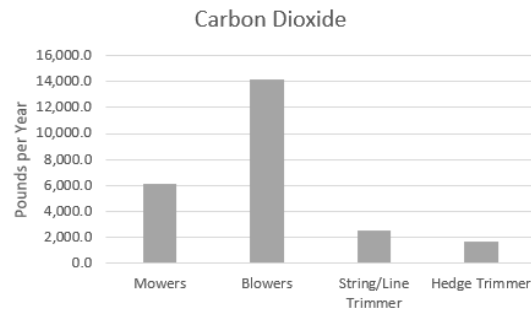


B. Annual Greenhouse Gases

Gas-powered maintenance of the selected properties produces 24,532 pounds (12.3 tons) of CO₂ each year. The amount of CO₂ emitted annually by tool type is shown in the Exhibit below.

Exhibit 2. Amount of Greenhouse Gases by Type of Tool

Exhibit 1



VI. OTHER IMPACTS

- **Noise** from gas-powered landscape maintenance equipment at the ear of the operator generally exceed the occupational safety standard of 85 decibel (A-weighted) average over an 8 hour day, some up to 1000-times based on the exponential decibel scale (PLANET, 2012). At 50 feet, most exceed thresholds considered safe for health and hearing (WHO Guidelines; EPA Levels, 1974). Chronic loud noise may cause irreversible hearing damage, cognitive and psychological problems, sleep disruption, and contribute to heart disease and other stress-related disorders. Loud noise is particularly problematic around playgrounds, schools, homes, and offices in which people are working, studying, or simply trying to enjoy themselves indoors or outdoors. Children with autism and people with hearing and sensory deficit disorders are especially vulnerable. Loud noise is also known to disrupt animal communications and decrease biodiversity.
- **Fuel spillage** into ground and drains occurs when equipment is refueled.
- **Toxic and solid waste** from maintaining gas equipment (chemicals, solid containers and parts – e.g., spark plugs, air and oil filters, belts, hoses, carburetor cleaner, engine degreasers, etc) create substantial waste streams consisting of solid parts containing toxic chemicals and solid non-recyclable containers with toxic chemical residues. These wind up in landfills and can contribute to soil and water contamination.

VII. BENEFITS

The results of the ELF indicate that transitioning to battery electric equipment can substantially reduce harmful exhaust emissions and greenhouse gases as well as noise exposure for workers and the public, fuel spillage, and solid and toxic waste.

- Battery electric equipment and manual tools produce no toxic and carcinogenic exhaust emissions.
- Battery electric equipment and manual tools produce no carbon dioxide.
- AGZA-approved battery electric equipment has been estimated to reduce sound levels by 45% – 70%, relative to gas equipment.
- Because battery electric equipment does not run on liquid fuel, fuel spillage is eliminated when gas equipment is replaced.
- The crew does not have to carry or mix the gas and oil needed for gas powered handheld equipment.
- The toxic and solid waste stream of gas-related parts and maintenance is completely eliminated for all fully retired gas tools that are replaced by electric alternatives.

In addition to the environmental and health benefits of transitioning away from gas equipment, there are other important benefits.

- Elimination of gas equipment vibration that can cause neurological damage and other harm to worker health.
- A heightened awareness throughout the community about how Glendale is creating a more pleasant and sustainable environment for its citizens.
- Recognition of Glendale as a regional and national leader in zero-emissions, low-noise maintenance, helping to strengthen its reputation as an environmental steward.
- Enhanced ability to engage local landscaping businesses in following Glendale's example inspiring further impact reductions.
- Long-term benefits from citizens raising expectations about sustainability in all aspects of their lives: zero-emission residential lawn care, electric or other zero-emission cars, rooftop solar, renewable energy infrastructure, etc.

Exhibit 1

VIII. CLOSING STATEMENT

The City of Glendale has made an important transition -- away from fossil fuels to zero emissions, low noise battery electric tools to maintain several municipal properties and becoming eligible for AGZA Green Zone certification. The transition promises substantial benefits for the health of workers, the public and the environment. Further, Glendale stands to realize long-term savings accruing from eliminated fuel consumption and reduced maintenance. In addition to healthier working conditions, work crews benefit from recognition and pride in the work they do. Residents benefit from cleaner, quieter neighborhoods, schools, businesses and public spaces. AGZA commends the City of Glendale on its leadership!