

Electrifying: Facilitating the Transition To Electric Lawn and Garden Equipment

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INTRODUCTION

As the automobiles on America's roads have grown more environmentally friendly in recent decades, a different fleet of emitters has continued to lurk in the nation's garages and backyards. Some small gas-powered lawn and garden equipment products ("LGE")¹ sold in hardware and big box stores today, emit pollutants at levels exceeding those of cars and trucks.²

For instance, a 2011 Edmunds study concluded a simple two-stroke leaf blower emitted twice the quantity of nitrogen oxides as a 6,200-pound Ford F-150 SVT Raptor.³ The leaf blower also emitted twenty-three times as much carbon monoxide and 299 times as many non-methane hydrocarbons as the large truck.⁴ According to the study, the Raptor would have to travel for 3,887 miles to produce as many hydrocarbon emissions as the leaf blower generates in thirty minutes of ordinary yard work.⁵ Although nearly a decade has passed since this study was taken, the Environmental Protection Agency ("EPA") has yet to

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¹ See 40 C.F.R. § 1054.1 (2010) (regulating new spark-ignition engines with maximum power at or below 19 kilowatts or 25 horsepower covering LGE which includes lawn mowers, leaf blowers, trimmers, edgers, cutters, chippers, rotary tillers, stump grinders, shredders, snowblowers, tractors, turf equipment, and other lawn tools).

² See Jason Kavanagh, *Emissions Test: Car vs. Truck vs. Leaf Blower*, EDMUNDS (Dec. 5, 2011), <https://www.edmunds.com/car-reviews/features/emissions-test-car-vs-truck-vs-leaf-blower.html> [<https://perma.cc/P2HU-JCJW>].

³ *Id.*; see also Center for Science Education, *Nitrogen Oxides*, UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH (2017), <https://scied.ucar.edu/nitrogen-oxides> [<https://perma.cc/R84B-7VKM>] (describing nitrogen oxides as highly reactive combustion byproducts contributing to the formation of ozone, acid rain, and smog).

⁴ *Id.*

⁵ *Id.*

substantially increase federal emissions standards applicable to most small nonroad engines.⁶

Many of the gas-powered LGE products sold in the U.S. today emit startling amounts of harmful gases because they continue to rely on decades-old designs.⁷ Policymakers have compelled automobile manufacturers to reduce the output of vehicle emissions over the years through technologies like catalytic converters, advanced combustion techniques, and computer-controlled fuel injection.⁸ Unfortunately, regulators have devoted far less attention to driving emissions reductions in LGE engines.⁹

The regulatory gaps allowing heavy-emitting LGE to persist in the U.S. create significant environmental and health hazards.¹⁰ One EPA study found gas-powered LGE generates eight percent of the United States dangerous benzene and “1,3 butadiene”¹¹ emissions.¹² The study also found two-stroke engines like those used in many types of LGE are a major source of fine particulate exhaust, which is known to elevate risks of cancer,¹³ heart disease, stroke, lung disease, and premature death.¹⁴ Although gas-powered LGE undoubtedly serve as valuable landscaping tools throughout the U.S., they are responsible for roughly five percent of America’s air pollution,¹⁵ substantial

⁶ See 40 C.F.R. § 1054.101 (2010).

⁷ See Ryan Cooper, *The government must regulate lawn equipment. Seriously.*, THE WEEK (Nov. 28, 2017), <https://theweek.com/articles/739688/government-must-regulate-lawn-equipment-seriously> [<https://perma.cc/Y2H9-E38D>].

⁸ *Id.*

⁹ *Id.*

¹⁰ See Jamie L. Banks & Robert McConnell, *National Emissions from Lawn and Garden Equipment*, EPA (2015), <https://www.epa.gov/sites/production/files/2015-09/documents/banks.pdf> [<https://perma.cc/WHD3-5S9N>].

¹¹ See Daniel I. Rubenstein & Sheryl Telford, *Final Report of the New Jersey Comparative Risk Project* (2003), <https://www.state.nj.us/dep/dsr/njcrp/njcrp-final.pdf> (explanatory parenthetical) [<https://perma.cc/7NWB-Y69X>].

¹² See Banks & McConnell, *supra* note 10.

¹³ See Kurt Straif et al., *Air Pollution and Cancer*, INTERNATIONAL AGENCY FOR RESEARCH IN CANCER, WORLD HEALTH ORGANIZATION (2013), <https://publications.iarc.fr/Book-And-Report-Series/Iarc-Scientific-Publications/Air-Pollution-And-Cancer-2013> [<https://perma.cc/F7JA-2U6S>].

¹⁴ *Id.*

¹⁵ See PEOPLE POWERED MACHINES, *Cleaner Air: Gas Mower Pollution*, <https://www.peoplepoweredmachines.com/faq-environment.htm> [<https://perma.cc/N2L5-BPCG>] *Facts*; see also Banks & McConnell, *supra* note 10, at 7 (finding that gas-powered LGE contributes significantly to the nation’s total GHG emissions, including approximately 17% of all volatile organic compound emissions, 12% of nitrogen oxide emissions, 29% of carbon monoxide emissions, and 4% of carbon dioxide emissions); see also *Outdoor Carbon Monoxide Poisoning Attributed to Tractor Exhaust* (1997), CDC

ground level ozone pollutants, greenhouse gas emissions (“GHG”), and other harmful emissions.¹⁶ Even as the unjustifiable environmental and health risks associated with gas-powered LGE have grown more conspicuous in recent years, many manufacturers have been slow to integrate new technologies such as electric motors into their products to mitigate those risks.¹⁷

This Article examines how policy deficiencies have slowed progress toward electrification and decarbonization within the LGE industry in recent decades and identifies specific federal, state, and local policies capable of addressing these shortcomings. At the federal level, a combination of strong and predictable retail tax incentives and national LGE emissions standards growing stringent over time would do much to promote emissions reductions within the industry. And, although each state faces its own unique challenges with respect to LGE, state governments and electric utilities regulated at the state level would be well suited to offer various programs capable of further promoting the adoption of electric LGE technologies. Even at the municipal government level, there are myriad potential ways to promote reductions in LGE-related emissions. Collectively, such proactive government efforts at all levels could drive much more rapid electrification of the equipment used in the nation’s backyards and gardens.

Part I of this Article sets forth detailed background information on the LGE equipment industry and its public

MORBIDITY & MORTALITY WEEKLY REPORT,
<https://www.cdc.gov/mmwr/preview/mmwrhtml/00050544.htm> [<https://perma.cc/ZB77-AXK3>] (last viewed Nov. 8, 2020) (attributing carbon monoxide poisoning to inhaling tractor exhaust).

¹⁶ See PEOPLE POWERED MACHINES, *Cleaner Air: Gas Mower Pollution Facts*, <https://www.peoplepoweredmachines.com/faq-environment.htm> [<https://perma.cc/N2L5-BPCG>] (last viewed Oct. 5, 2020); see also Banks & McConnell, *supra* note 10, at 7 (finding that gas-powered LGE contributes significantly to the nation’s total GHG emissions, including approximately 17% of all volatile organic compound emissions, 12% of nitrogen oxide emissions, 29% of carbon monoxide emissions, and 4% of carbon dioxide emissions); see also MORBIDITY AND MORTALITY WEEKLY REPORT, *Outdoor Carbon Monoxide Poisoning Attributed to Tractor Exhaust* (1997), CENTER FOR DISEASE CONTROL <https://www.cdc.gov/mmwr/preview/mmwrhtml/00050544.htm> [<https://perma.cc/ZB77-AXK3>] (attributing carbon monoxide poisoning to inhaling tractor exhaust).

¹⁷ Compare Tim Palucka, *Doing the Impossible*, INVENTION & TECHNOLOGY (2004), <https://www.inventionandtech.com/content/doing-impossible-0> [<https://perma.cc/VST5-K5JD>] (describing the quick technological improvements made in the auto industry with secondary air injection, exhaust gas recirculation, and catalytic converters) with Cooper, *supra* note 7 (arguing that gas-powered LGE was responsible for 24–45 percent of non-road gasoline emissions and that within a few years gas-powered LGE will be the biggest source of ozone pollution in California).

health, environmental, and economic effects. Part II describes and critiques the existing set of policies governing LGE and their emissions within the U.S. Part II further explains how the limitations of existing federal, state, and local governments have hampered the national push to transition to electric LGE. Part III describes specific policies implementable at the federal, state, and local levels that could facilitate a more accelerated and cost-effective transition toward an all-electric LGE industry.

I. LAWN AND GARDEN EQUIPMENT: SMALL ENGINES -BIG EMITTERS

Lawn care and the regular tending of front and backyard areas are practices existing for hundreds of years.¹⁸ Originating centuries ago in agricultural and animal husbandry settings with grazing pens and other enclosed grassy areas, lawns have gradually developed into areas where people could gather in idyllic outdoor spaces managed by their own hands.¹⁹ LGE technologies aimed at simplifying lawn and garden care are traceable back to at least 1830, when English engineer Edwin Bunning created the first wheel-driven push lawn mower.²⁰ Championed as a time-saving tool, these first lawn mowers could do the work of more than a half dozen people using handheld devices.²¹

Technological advancements continued to dramatically reshape the lawn and garden care industry throughout the early twentieth century, when internal combustion engines and early push-reel lawn mower designs made it possible to keep lawns and gardens tidy without nearly as much time or intense physical labor.²² As technologies improved over this period, lawn and

¹⁸ See Planet Natural Research Center, *Lawn History*, PLANET NATURAL (2019), <https://www.planetnatural.com/organic-lawn-care-101/history/> [https://perma.cc/PQ2X-MZS9].

¹⁹ See Courtney Ruby, *Let it Grow: Freeing the Lawn from Aesthetically Rigid and Environmentally Damaging Real Covenants*, 87 UMKC L. REV. 435, 436 (2019).

²⁰ See Mary Bellis, *Greener Pastures: The Story of the First Lawn Mower*, THOUGHTCO. (Mar. 1, 2019), <https://www.thoughtco.com/first-lawn-mower-1991636> [https://perma.cc/D6GT-DPHZ].

²¹ See Louise Harmon, *Honoring our Silent Neighbors to the South: The Problem of Abandoned or Forgotten Asylum Cemeteries*, 34 TOURO L. REV. 901, 952-53 (2018) (citing MEG GREENE, *REST IN PEACE: A HISTORY OF AMERICAN CEMETERIES* 46-47 (2008)).

²² See Matt Jonas, *Cleaner Air: The Environmental Impacts of Gas Lawn Mowers*, CENTER FOR ENVTL. TRANSFORMATION (Feb. 14, 2020), <https://www.cfet.org/cleaner-air-the-environmental-impacts-of-gas-lawn-mowers/> [https://perma.cc/AH55-2HEV].

garden tools were seen less as labor-saving devices and more as work-expanding tools.²³ Unfortunately, these powerful combustion engine-driven technologies also brought air emissions with them having since posed significant environmental and human health risks.²⁴

By the 1960s, United States policymakers began to notice the dangers of air emissions from gas-powered engines and to seek ways to reduce those dangers.²⁵ In 1963, Congress enacted the Clean Air Act (“CAA” or “the Act”), a comprehensive statute aimed at reducing harmful emissions from a variety of sources.²⁶ Among other things, the Act empowered the EPA to regulate emissions of air pollutants from a wide range of sources, including LGE engines.²⁷ LGE combustion engines were not substantially regulated, however, until 1998.²⁸ Although technological strides during the late twentieth century included some early electric designs, most still lacked the power and durability of gas-powered models.²⁹

Sadly, the regulatory environment since that time has not sufficiently incentivized LGE manufacturers to pursue a transition more aggressively toward all-electric product fleets even though the technologies needed for such a transition have increasingly been available.³⁰ Indeed, electric motor technologies today are often capable of supporting the development of LGE products comparable to or better than gas-powered counterparts in the same price range.³¹

²³ See Dale C. Doerhoff et al., *Facing the Lawn Boy Conundrum at Home and at the Office*, 59 J. MO. B. 114, 140 (2003).

²⁴ *The Evolution of Lawn Mowers Throughout History*, POWERPRO EQUIPMENT, <https://www.powerproequipment.com/evolution-lawn-mowers-throughout-history> [<https://perma.cc/G243-DJWN>] (last viewed Jan. 20, 2021).

²⁵ See U.S. ENVTL. PROT. AGENCY, *History of Air Pollution* (2020), <https://www.epa.gov/air-research/history-air-pollution> [<https://perma.cc/D9FD-W42Y>].

²⁶ See 42 U.S.C. § 7401 (West 1963).

²⁷ See U.S. ENVTL. PROT. AGENCY, *Clean Air Act Requirements and History* (2020) <https://www.epa.gov/clean-air-act-overview/clean-air-act-requirements-and-history> [<https://perma.cc/A56W-2HH7>].

²⁸ See Bellis, *supra* note 20, at 452.

²⁹ See James M. Liston, *GE Introduces the Electric Tractor*, POPULAR MECHANICS (1970) (e.g., General Electric introduced the first production-line, electric-powered home tractor in 1970; the Electrak was able to mow 3.5 acres without recharging and touted a “cool, quiet, safe, and vibration-free” engine that could outperform conventional 10, 12, and 14 horsepower tractors of the time.)

³⁰ *But see EPA sets lower emissions regulations for mowers*, CONSUMER REPORT NEWS (Oct. 2, 2008, 4:09 AM), <https://www.consumerreports.org/cro/news/2008/10/epa-sets-lower-emissions-regulations-for-mowers/index.htm> [<https://perma.cc/NN83-GHQA>].

³¹ See Paul Hope, *Electric Lawn Mowers That Rival Gas Models*, CONSUMER

Transitioning from gas-powered to electric LGE technologies is becoming ever more imperative as concerns continue to mount regarding the adverse environmental impacts of fossil fuel engines.³² Despite these concerns, gas-powered lawn and garden care tools comprise a multi-billion-dollar industry with the U.S. market alone likely to reach roughly thirteen billion dollars in revenue within the next five years;³³ even though electric models increasingly lead their markets in almost all performance categories.³⁴

Incredibly, although electric LGE models are the smart choice in new equipment, the global market share for electric lawn mowers is still less than 30 percent and the U.S. plays a relatively minor role in the market.³⁵ LGE manufacturers continue to profit handsomely from gas-powered technologies, and their reluctance to embrace electric-powered models has made LGE among the most unjustifiable polluters in the world.

A. *Compare and Contrast: Gas vs. Electric LGE*

Transitioning to an all-electric LGE industry could benefit the nation and the world in several ways, many of such benefits are not fully accounted for under existing policies governing LGE products. Operating gas-powered LGE produces many negative externalities, including potentially harmful emissions and noise levels.³⁶ Conversely, the use of clean, sustainable electric LGE

REPORTS (Apr. 6, 2017), <https://www.consumerreports.org/push-mowers/electric-lawn-mowers-that-rival-gas-models/> [<https://perma.cc/KES2-SNFS>].

³² See *Electrification: The Time is Now*, Analysis, ELECTRIFICATION COALITION (2011), <https://www.electrificationcoalition.org/electrification-the-time-is-now/> [<https://perma.cc/2TJG-ZH99>].

³³ See Arizton, *US Lawnmowers Market - Opportunity and Growth Assessment 2019-2024*, RESEARCH & MARKETS (May 2019), <https://www.researchandmarkets.com/reports/4771009/us-lawnmowers-market-opportunity-and-growth> [<https://perma.cc/H8U4-YUQS>].

³⁴ See Paul Hope, *How Green Are Electric Lawn Mowers?*, CONSUMER REPORTS (Jul. 28, 2018), <https://www.consumerreports.org/lawn-mowers-and-tractors/how-green-are-electric-lawn-mowers/> [<https://perma.cc/WXM3-UQSU>].

³⁵ See Market Research Report, *Lawn Mowers Market Size, Share & Trends Analysis Report By Product (Petrol, Electric, Manual, Robotic), By End Use (Residential, Commercial & Govt.), By Region (MEA, Asia Pacific, North America), And Segment Forecasts, 2019 - 2027*, GRAND VIEW RESEARCH (Feb. 2020), <https://www.grandviewresearch.com/industry-analysis/lawn-mowers-market> [<https://perma.cc/CLL9-Y3CJ>].

³⁶ See ARTHUR PIGOU, *THE ECONOMICS OF WELFARE* 183 (4th ed. 1932) (defining an externality as a cost or benefit imposed on a third party resulting from an action taken by someone other than that third party).

produces positive externalities.³⁷ While transitioning to an almost entirely electric LGE industry could be difficult and costly in the short term, the net long-term environmental, health and economic gains from such a move are likely to outweigh the costs of continued reliance on gas-powered equipment.

i. Air emissions impacts

In an era of unending policy debates over strategies for curbing harmful emissions and climate change, gas-powered LGE have gone largely unnoticed.³⁸ Many gas-powered LGE emit substantial amounts of carbon monoxide, volatile organic compounds (key in the formation of ground-level ozone),³⁹ nitrogen oxides, and other harmful emissions.⁴⁰ Gas-powered LGE also contribute to numerous human health risks including lung cancer, cardiopulmonary disease, emphysema, respiratory infections, and carbon monoxide poisoning.⁴¹ Emissions from gas-powered LGE can even inhibit plant growth, thereby further exacerbating their climate change-inducing effects.⁴² Indeed, it will be difficult for the nation to reach its long-term GHG reduction goals without greatly reducing emissions from gas-powered LGE.

³⁷ See HARVEY S. ROSEN, PUBLIC FINANCE 86 (10th ed. 2014) (explaining positive externality problems and how such problems may be addressed through Pigouvian subsidies).

³⁸ See generally Michael P. Vandenberg, *From Smokestack to SUV: The Individual as Regulated Entity In the New Era of Environmental Law*, 57 VAND. L. REV. 515, 549 (2004) (describing lawn and gardening equipment as among some of the most innocuous polluters other than vehicles).

³⁹ See American Lung Association, *State of the Air 2019: 20th Anniversary* (2019), <https://www.lung.org/assets/documents/healthy-air/state-of-the-air/sota-2019-full.pdf> [<https://perma.cc/B2AE-YWJQ>].

⁴⁰ See Rubenstein & Telford, *supra* note 11, at 12 (stating that in addition to cancer, pollutants from LGE cause or contribute to early death, heart attack, stroke, congestive heart failure, and chronic obstructive pulmonary disease).

⁴¹ See Brian Palmer, *How bad for the environment are gas-powered leaf blowers?*, WASHINGTON POST (Sept. 16, 2013) (explaining how the leading culprit in harmful emissions is the two-stroke engine which emits a significant number of air pollutants as a byproduct of its function including, large quantities of carbon monoxide, nitrous oxides and hydrocarbons) https://www.washingtonpost.com/national/health-science/how-bad-for-the-environment-are-gas-powered-leaf-blowers/2013/09/16/Seed7b9a-18bb-11e3-a628-7e6dde8f889d_story.html?noredirect=on [<https://perma.cc/DE2X-SA3S>].

⁴² See Ozlem Kar Kurt, Jingjing Zhang, Kent E. Pinkerton, *Pulmonary Health Effects of Air Pollution*, CURRENT OPINION IN PULMONARY MEDICINE (Mar. 2016), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4776742/> [<https://perma.cc/WUX8-QJ44>].

Unfortunately, under existing policies, many of the environmental and health costs of gas-powered LGE are not presently reflected in the retail prices Americans pay for these products.⁴³ And many of the costs associated with air pollution are borne disproportionately by low income and minority communities.⁴⁴

The gasoline fuel used to fuel the nation's vast fleet of gas-powered LGE creates its own set of costs.⁴⁵ Americans annually consume more than 1.2 billion gallons of gasoline for lawn mowing alone.⁴⁶ Even worse, the exhaust produced from burning this fuel accounts for between 24 and 45 percent of all non-road gasoline emissions.⁴⁷ Moreover, the EPA estimates, during the seemingly simple process of refueling LGE, at least 17 million gallons of gasoline are spilled annually,⁴⁸ exceeding all of the oil spilled in the infamous Alaska Exxon Valdez oil spill.⁴⁹ This spilled gasoline often pollutes groundwater and seeps into waterways throughout the U.S.⁵⁰

In addition to contaminating groundwater, evaporated fuel can substantially add to ground level ozone pollution and smog problems in metropolitan areas.⁵¹ Indeed, these evaporative

⁴³ See generally Matthew E. Kahn, *The Beneficiaries of Clean Air Act Regulation*, REG. MAG., at 34–37 (Spring 2001) (showing that less wealthy people and minorities in the Los Angeles Basin experienced greater improvements in air quality than wealthier people based on the spatial distribution of air pollutants while wealthier people tended to bear the costs of newer, cleaner vehicle ownership).

⁴⁴ See *id.*

⁴⁵ See generally *Alternative Fuel and Advanced Technology Commercial Lawn Equipment*, DEP'T. OF ENERGY (2014) https://afdc.energy.gov/files/u/publication/lawn equip_2014.pdf [<https://perma.cc/P4Q7-ZNW7>].

⁴⁶ See *id.* (stating that commercial lawn mowing accounts for about 35% of gasoline consumption).

⁴⁷ See Rubenstein & Telford, *supra* note 11, at 1.

⁴⁸ See Cecil Adams, *How Much Pollution Do Gasoline-Powered Lawn Mowers Cause?*, WASHINGTON CITY PAPER (Nov. 12, 2010), <https://www.washingtoncitypaper.com/columns/straight-dope/article/13039806/straight-dope-how-much-pollution-do-gasoline-powered-lawn-mowers> [<https://perma.cc/9UY3-2E9R>].

⁴⁹ See United States Environmental Protection Agency, *Exxon Valdez Spill Profile* (Jan. 19, 2017), <https://www.epa.gov/emergency-response/exxon-valdez-spill-profile> [<https://perma.cc/FGT2-4K8F>].

⁵⁰ See Illinois Department of Public Health, *Gasoline, Cancer in Illinois*, <http://www.idph.state.il.us/cancer/factsheets/gasoline.htm> [<https://perma.cc/9XDK-NSX9>] (last viewed Nov. 8, 2020) (analyzing the different health risks associated with gasoline exposure).

⁵¹ See David Piantanida, *Green Things Come in Large Packages*, THE EPA BLOG (Aug. 5, 2008), <https://blog.epa.gov/2008/08/05/green-things-come-in-large-packages/> [<https://perma.cc/6AK9-N7NK>].

emissions are often more harmful than exhaust emissions because they are directly emitted into the atmosphere.⁵² Gas-powered LGE raise a unique evaporative emissions concerns because they are commonly stored in enclosed spaces.⁵³

Authorities have warned vapors escaping from gas-powered LGE inside of attached garages can potentially intrude into homes and pose health risks to anyone inside.⁵⁴ Accordingly, reducing gasoline use in LGE by transitioning to electric products could produce significant public health benefits.⁵⁵

As air emissions regulations affecting other industries and products have become more stringent over the years, the lax rules governing gas-powered LGE have increasingly stood out like a sore thumb. For instance, gas-powered LGE will soon be the largest source of ozone pollution in California.⁵⁶ And fossil-fuel power plants have long been required to comply with emissions standards stricter than those applicable to gas-powered LGE.⁵⁷ Some have argued even if the nation's power were supplied solely from fossil fuel sources, electrifying all LGE would still be beneficial because it avoids emitting pollution in citizens' backyards where equipment users and bystanders often breathe in the harmful exhaust.⁵⁸ Regardless, as electric utilities in the U.S. steadily increase their reliance on renewable energy sources,⁵⁹ the benefits of transitioning to all-electric LGE continue to grow.

⁵² See John H. Johnson, *Automotive Emissions*, MICH. TECHN. UNIV'Y. (1988), <https://www.ncbi.nlm.nih.gov/books/NBK218144/> [<https://perma.cc/JJ5L-VA57>].

⁵³ See Stuart Silverstein, *California Throttles Down Pollution from Small Engines*, KCET (Nov. 14, 2017), <https://www.kcet.org/shows/social-connected/california-throttles-down-pollution-from-small-engines> [<https://perma.cc/9C7C-QF6N>].

⁵⁴ See *id.*

⁵⁵ See generally Roberta Barkman James, *Oil and the Environment: Reducing Oil Dependency in the Automotive Sector*, 15 U. BAL. J. ENVTL. L. 1 (2007) (arguing that reducing oil dependency is appropriate due to the environmental harm oil causes, the global conflicts surrounding access to oil, and oil's non-renewable character).

⁵⁶ See California Air Resources Board, *Small Engines in California* (Aug. 9, 2017), <https://ww2.arb.ca.gov/resources/fact-sheets/small-engines-california> [<https://perma.cc/5V6J-7ZSX>].

⁵⁷ See Center for Climate and Energy Solutions, *Regulating Power Sector Carbon Emissions*, C2ES (providing an overview of power plant emissions and correlative regulations) <https://www.c2es.org/content/regulating-power-sector-carbon-emissions/> [<https://perma.cc/CK89-E2GZ>].

⁵⁸ See generally Alexandra B. Klass & Andrew Heiring, *Life Cycle Analysis and Transportation Energy*, 82 BROOK. L. REV. 485, 511–21 (2017) (comparing the net environmental effects of electric vehicles between direct (or tailpipe) emissions and life cycle emissions).

⁵⁹ See Nat'l Renewable Energy Lab'y, *Renewable Electricity Futures Study*,

ii. Occupational hazard and noise impacts

In addition to improving urban air quality, a transition to all-electric LGE would benefit the hundreds of thousands of landscaping industry employees throughout the country who have long borne a disproportionate share of the hidden health costs associated with maintaining America's lawns. Operating gas-powered LGE presents unique occupational hazards and health risks to the nearly one million people who regularly operate gas-powered LGE.⁶⁰ Among other things, landscaping workers who spend countless hours operating gas-powered LGE are exposed to elevated levels of particulates known to pose breathing hazards.⁶¹ Asthmatics and those with other respiratory conditions are particularly likely to experience aggravating problems from the relatively high concentrations of particulates emitted by many types of gas-powered LGE.⁶²

In addition to emissions-related health hazards, LGE can also produce high levels of noise potentially contributing to hearing loss with prolonged use.⁶³ Many gas-powered LGE products produce maximum decibel levels in excess of eighty-five decibels ("dBA").⁶⁴ Such noise not only makes communicating on

DEPT OF ENERGY (2012), <https://www.nrel.gov/analysis/re-futures.html> [https://perma.cc/5T82-F4EG].

⁶⁰ See Jackie DiFrancesco, Asha Brogan & Bryan Beamer, *Grounds for Change: Reducing Noise Exposure in Grounds Management Professionals – Part 1*, NIOSH SCI. BLOG (July 25, 2018), <https://blogs.cdc.gov/niosh-science-blog/2018/07/25/landscape-noise1/> [https://perma.cc/YJP9-PPG5] (noting an estimated 912,360 people in the US are employed as landscapers or groundskeepers, with another 100,320 employed as first-line supervisors of landscaping, lawn service and grounds keeping workers); see also Ellen Kerns, Elizabeth A. Masterson, Geoffrey M. Calvert, *Cardiovascular conditions, hearing difficulty, and occupational noise exposure within US industries and occupations*, AMERICAN JOURNAL OF INDUSTRIAL MEDICINE (June 2018), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6897488/> [https://perma.cc/D78U-RC5J].

⁶¹ A recent Fair Warning test concluded that the concentration of particulate matter near gas-powered LGE equipment was more than 50 times higher than at a nearby traffic-clogged intersection. See Hovaness C. Dekeyan, *Industrial Hygiene Survey*, HEALTH SCI. ASSOCIATES 9–14 (Aug. 9, 2017), <https://www.fairwarning.org/wp-content/uploads/2017/09/HSA-Report.pdf> [https://perma.cc/SM6X-MPYS].

⁶² See N.H. Dep't of Env't Services, *Take Steps to Limit Air Emissions: Use Electric Lawn & Garden Equipment* (2018), <https://www.des.nh.gov/organization/commissioner/pip/factsheets/ard/documents/ard-22.pdf> [https://perma.cc/PY7E-KMZR].

⁶³ See Consumer Prod. Safety Comm'n, 39 Fed. Reg. 26,662, 26,662 (July 22, 1974) (finding that noise hazards from power lawn equipment create the potential for hearing loss and non-auditory trauma from exposure to excessive noise).

⁶⁴ A study of occupational noise exposure among groundskeepers in North

the job more difficult for many landscapers, it can also potentially damage hearing function if sustained over extended periods.⁶⁵

Hearing loss is considered one of the most common occupational injuries in the U.S., and excessive exposure to noisy gas-powered engines significantly contributes to this problem.⁶⁶ Chronic noise exposure and accompanying hearing loss may also contribute to mental health issues such as anxiety and depression.⁶⁷ Using electric motor technologies to reduce the noise levels associated with LGE equipment thus creates additional public health benefits by reducing the incidence of hearing damage for LGE users and bystanders.⁶⁸

iii. Economic impacts

In addition to generating the environmental and public health benefits just described, a transition to electric LGE could produce significant economic benefits across the nation. A growing number of electric LGE are commercially available, and the electric LGE industry is currently producing rapid improvements in technology, efficiency, and price.⁶⁹ These improvements, together with advancements in electric battery technologies⁷⁰ and declining battery costs, are already helping

Carolina found noise levels from lawn mowers to be between 85 and 96 decibels, with other lawn equipment as high as 109 dBA. See Jo Anne G. Balanay, Gregory D. Kearney & Adam J. Mannarino, *Assessment of Occupational Noise Exposure among Groundskeepers in North Carolina Public Universities*, ENV'T HEALTH INSIGHTS 2 (Jan. 2016), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4909058/> [<https://perma.cc/9W55-KFMD>].

⁶⁵ See Nat'l Inst. on Deafness and Other Comm'n Disorders, *Noise-Induced Hearing Loss*, U.S. DEP'T OF HEALTH & HUM. SERVICES (last updated May 31, 2019), <https://www.nidcd.nih.gov/health/noise-induced-hearing-loss> [<https://perma.cc/5CXV-CX5J>].

⁶⁶ *Id.*

⁶⁷ See Stig Arlinger, *Negative consequences of uncorrected hearing loss—a review*, INT. J. OF AUDIOL. (2003), <https://www.ncbi.nlm.nih.gov/pubmed/12918624> [<https://perma.cc/D427-TYST>].

⁶⁸ See Jackie DiFrancesco, Asha Brogan, Bryan Beamer, *Grounds for Change: Reducing Noise Exposure in Grounds Management Professionals*, NIOSH (Jul. 25, 2018), <https://blogs.cdc.gov/niosh-science-blog/2018/07/25/landscape-noise1/> [<https://perma.cc/5QNR-XYTM>].

⁶⁹ See, e.g., Electric Tractor Inc., *The Electric Tractor*, <http://www.electricttractor.com/> [<https://perma.cc/33E5-WU4S>].

⁷⁰ See Energy Efficiency & Renewable Energy, *Clean Cities Guide to Alternative Fuel Commercial Lawn Equipment*, DEP'T OF ENERGY at 6 (2011) (describing how new battery powered LGE can last up to 80 minutes, creating the potential for electric LGE on a commercial scale).

facilitate this transition, but much more could be done to accelerate it.⁷¹

Although purchasing electric LGE often involves higher up-front costs than merely purchasing gas-powered models, the long-term benefits of electric LGE make them an increasingly attractive option. This is because the fuel, operation, and maintenance costs of electric LGE are usually lower than their gas-powered alternatives and these savings can offset differences in purchase price over the electric product's useful life.⁷² For instance, factoring in the cost of fuel, maintenance, and blade replacement, an average gas-powered mower costs an estimated \$725 over the course of ten years.⁷³ In contrast, a corded electric mower, including electricity and blade replacement, would cost only about \$359 over the same period.⁷⁴ And a cordless electric mower, including electricity, battery replacement, and blade replacement, would cost approximately \$506.⁷⁵

Many electric LGE are also arguably more convenient to use and refuel because users can simply charge them at home rather than having to drive to service stations to refill their gas can. Electric LGE likewise typically have fewer moving parts and do not rely on ignition start systems, making them generally easier and safer to operate and store.⁷⁶ And electric LGE tend to require significantly fewer maintenance costs over their useful life than gas-powered LGE.⁷⁷

⁷¹ See Camila Domonoske, *As More Electric Cars Arrive, What's The Future For Gas-Powered Engines?*, NPR (Feb. 16, 2019), <https://www.npr.org/2019/02/16/694303169/as-more-electric-cars-arrive-whats-the-future-for-gas-powered-engines> [https://perma.cc/V6JS-9KNW].

⁷² See Andrew Twite, *Electrifying cars and buses*, FRESH ENERGY (2017), <https://fresh-energy.org/electrifying-cars-and-buses/> [https://perma.cc/YWB5-JRP7].

⁷³ See Dr. Penny Pincher, *We Do the Math: Will an Electric Mower Trim Lawn Care Costs?*, WISEBREAD (Aug. 2, 2017), <https://www.wisebread.com/we-do-the-math-will-an-electric-mower-trim-lawn-care-cost> [https://perma.cc/5SBR-4H2M].

⁷⁴ *Id.*

⁷⁵ *Id.*

⁷⁶ See Sarah Eberle, *Best Electric Start Self Propelled Lawn Mower for the Money*, SARAH EBERLE LANDSCAPE DESIGN (Sep. 8, 2020), <https://www.saraheberle.com/electric-start-self-propelled-lawn-mower/>, [https://perma.cc/QF67-ZXTU]; see generally Daniel Wroclawski, *Lawn Mower Face-Off: Ego Battery-Powered Electric Mower vs. Honda Gas Mower*, CONSUMER REP. (May 18, 2019), <https://www.consumerreports.org/lawn-mowers-and-tractors/ego-electric-mower-vs-honda-gas-mower-face-off/> [https://perma.cc/2EW3-M88X] (comparing advantages and disadvantages of gas and electric LGE).

⁷⁷ See, e.g., Pincher, *supra* note 73 (comparing the maintenance costs of electric and gas lawnmowers).

B. The History of EPA Emission Regulations of Small Non-road Spark-Ignition Engines

The small non-road spark-ignitions found in many types of LGE today have largely fallen through the cracks of EPA policymaking despite being major sources of airborne pollution.⁷⁸ Prior to 1995, all emissions from small non-road engines were unregulated, allowing inefficient gas-powered engines to pollute with few constraints.⁷⁹ In 1995, the EPA first adopted regulations, spearheaded by California under its CAA waiver authority, for small non-road spark-ignition engines.⁸⁰ The EPA's primary focus in these early regulations was to combat the contributions of these engines to ground-level ozone and reduce other major adverse impacts on the natural environment and human health.⁸¹

The EPA's existing emissions standards applicable to small spark-ignition engines like those found in many LGE models restrict emissions of nitrogen oxides, hydrocarbons, particulate matter, and carbon monoxide.⁸² By reducing toxic

⁷⁸ See U.S. EPA, *Frequently Asked Questions from Owners and Operators of Nonroad Engines, Vehicles, and Equipment Certified to EPA Standards*, OFFICE OF TRANSP. & AIR QUALITY (Aug. 2012), <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100U8YP.pdf>, [https://perma.cc/8SVB-R69H].

⁷⁹ See Emission Standards for New Nonroad Spark-ignition Engines at or Below 19 Kilowatts, 60 Fed. Reg. 127 (July 3, 1995) (to be codified 40 C.F.R. pt. 90).

⁸⁰ See *id.* at 2; see also CAL. AIR RESOURCES BOARD, *California & the Waiver: The Facts* (Sept. 17, 2019), <https://ww2.arb.ca.gov/resources/fact-sheets/california-waiver-facts>, [https://perma.cc/J3RE-3LM9] (providing the elements for California to utilize its waiver authority); see generally CAL. AIR RESOURCE BOARD, *Small Engines in California* (Aug. 9, 2017), <https://ww2.arb.ca.gov/resources/fact-sheets/small-engines-california> [https://perma.cc/8ZYC-PC5J] (stating that CARB adopted emissions standards for small engines in 1990 and was the first agency in the world to control emissions from these engines).

⁸¹ See Emission Standards for New Nonroad Spark-ignition Engines at or Below 19 Kilowatts, 60 Fed. Reg. 127, 2; see generally Agency for Toxic Substances and Disease Registry, *ToxFAQs for Nitrogen Oxides*, CENTER FOR DISEASE CONTROL: DIVISION OF TOXICOLOGY & HUMAN HEALTH SERVICES (Mar. 25, 2014), <https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=396&tid=69>, [https://perma.cc/6LMJ-XKD7] (explaining that exposure to these unhealthy pollutants poses serious health risks to humans and their emission into the atmosphere contributes to the formation of smog and acid rain).

⁸² See *EPA Finalizes Emission Standards for New Nonroad Spark-Ignition Engines, Equipment, and Vessels*, U.S. EPA OFFICE OF TRANSP. & AIR QUALITY (Sep. 2008), <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P10017GK.pdf> [https://perma.cc/8RR9-XVPH] [hereinafter U.S. EPA].

emissions from gas-powered LGE, these basic restrictions do help to mitigate some of the dangers these equipment pose to both human health and the environment.⁸³ These federal regulations usually apply to manufactures and distributors of small spark-ignition engines and address both evaporative and exhaust emissions.⁸⁴

Although LGE manufacturers must comply with federal standards set by the EPA, they are not required to use any specific emission control methods to meet those standards.⁸⁵ Instead, manufacturers must only ensure each new fleet of engines meet the latest emission standards, meaning once a manufacturer has placed the certified engine into the market, no further action is required.⁸⁶ Products built before EPA emission standards became applicable are generally not impacted by these regulatory requirements, commonly known as being “grandfathered in,” and owners are not required to retire old equipment no longer meeting modern day emission standards.⁸⁷

EPA regulation of small non-road spark-ignition engines to date has progressed in three phases.⁸⁸ First, the EPA issued the “Phase 1” rules, which established standards for new non-road spark-ignition engines at or below 19 kilowatts.⁸⁹ Secondly, “Phase 2” emission standards aimed to reduce hydrocarbons and nitrogen oxide emissions by 59 percent beyond the “Phase 1” standards.⁹⁰ These provisions were put in place to minimize the compliance burden on manufacturers while maintaining the environmental benefits of the rule.⁹¹ Tighter emission standards allowed for an efficient transition of engine designs and

⁸³ *See id.*

⁸⁴ *See New Phase 3 Engine Standards Affecting Retailers and Importers of Lawn and Garden Equipment*, U.S. EPA OFFICE OF TRANSP. & AIR QUALITY (Aug. 2009), <https://nepis.epa.gov/Exe/ZyPDF.cgi/P1006P00.PDF?Dockkey=P1006P00.PDF>, [<https://perma.cc/W39D-E4TQ>].

⁸⁵ *See* U.S. EPA, *supra* note 82, at 2.

⁸⁶ *Id.* at 1.

⁸⁷ *Id.*

⁸⁸ *Id.*

⁸⁹ *See* Emission Standards for New Nonroad Spark-ignition Engines at or Below 19 Kilowatts, 60 Fed. Reg. 127, 1.

⁹⁰ *See New Phase 2 Standards for Small Spark-Ignition Nonhandheld Engines*, U.S. ENVTL. PROTECTION AGENCY (Mar. 1999), <https://nepis.epa.gov/Exe/ZyPDF.cgi/P1001Z8R.PDF?Dockkey=P1001Z8R.PDF>, [<https://perma.cc/NKM9-YD7D>].

⁹¹ *Id.* at 5.

technologies from “Phase 1” standards to those necessary to meet the “Phase 2” requirements.⁹²

Currently, LGE are regulated under the EPA’s “Phase 3” requirements for exhaust emissions for small non-road spark-ignition engines. Taking effect in 2011 or 2012, depending on the size of the engine,⁹³ “Phase 3” compelled manufacturers of gas-powered LGE to further cut smog-forming emissions, continuing the process of establishing non-road engine standards authorized under the CAA.⁹⁴ “Phase 3” also requires proper labeling for engines and emission control systems.⁹⁵

The EPA’s existing regulations have helped small non-road spark-ignition engines to become cleaner, more efficient, and less harmful to both humans and the environment, but regrettably they have not been updated in over a decade.⁹⁶ In the interim, emissions control technologies and electric motor and energy storage technologies have substantially improved. In light of these changes, stricter EPA emissions regulations on LGE are long overdue.

C. Existing State and Local LGE Electrification Policies

Although the federal government is the primary agency responsible for enacting emissions standards for LGE, state implementation plans (“SIPs”) allow states to help enforce EPA regulations in some ways affecting the LGE industry.⁹⁷ Under

⁹² *Id.* at 3; *see also Regulations for Emissions from Small Equipment & Tools*, U.S. ENVTL. PROTECTION AGENCY, <https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-emissions-small-equipment-tools> [https://perma.cc/3HPW-SURT] (last viewed Oct. 2, 2020)

⁹³ *See Control of Emissions from Nonroad Spark-Ignition Engines and Equipment*, U.S. ENVTL. PROTECTION AGENCY (Oct. 8, 2008), <https://www.govinfo.gov/content/pkg/FR-2008-10-08/pdf/E8-21093.pdf> [https://perma.cc/WYC3-M9EX].

⁹⁴ *See Jasmin Melvin, EPA tightens lawn mower, motor-boat emission rules*, REUTERS (Sept. 5, 2008), <https://www.reuters.com/article/us-epa-emissions-rules/epa-tightens-lawn-mower-motor-boat-emission-rules-idUSN0547157820080905> [https://perma.cc/9JWV-VHZJ].

⁹⁵ *New Phase 3 Engine Standards Affecting Retailers and Importers of Lawn and Garden Equipment*, U.S. ENVTL. PROTECTION AGENCY (Aug. 2009), <https://nepisa.epa.gov/Exce/ZyPdf.egi/P1006P00.PDR?Dockery=P1006P00.PDF> [https://perma.cc/C8NK-HL4B].

⁹⁶ *Control of Emissions From Nonroad Spark-Ignition Engines and Equipment*, 73 Fed. Reg. 59034-01 (Oct. 8, 2008), www.federalregister.gov/documents/2008/10/08/E8-21093/control-of-emissions-from-nonroad-spark-ignition-engines-and-equipment [https://perma.cc/SG26-M9KA].

⁹⁷ *State Implementations Plans*, U.S. ENVTL. PROTECTION PLAN (Feb. 23, 2016),

this “cooperative federalism” approach, state laws function as the core of environmental programs, but only after receiving EPA approval.⁹⁸ The CAA generally prohibits states from implementing air quality laws more stringent than the national standard.⁹⁹ However, as an exception, California can receive a waiver from CAA preemption upon satisfaction of three specific requirements: (1) California’s standards are at least as protective as federal standards, and that the state’s determination of that fact was not arbitrary and capricious; (2) California’s standards are needed to meet compelling and extraordinary conditions; and (3) California’s standards are not inconsistent with certain CAA provisions relate to technical feasibility and lead time to manufacturers.¹⁰⁰ Other states can likewise receive a waiver from federal preemption by adopting California’s standards,¹⁰¹ but as of 2017, California had not enacted any recent emissions standards for LGE.¹⁰² Accordingly, until California attempts to implement new LGE emissions standards states desiring to impose rules more stringent emission standards on LGE than the federal rules have few options.¹⁰³

Despite having limited authority, a number of states across the country have enacted innovative policies to help

<https://www3.epa.gov/region02/air/sip/> [<https://perma.cc/SGG7-V3HF>].

⁹⁸ Kristen Engel, *State and Local Climate Change Initiatives: What is Motivating State and Local Governments to Address a Global Problem and What Does This Say About Federalism and Environmental Law?*, 38 URB. LAW. 1015, 1020 (2006) https://papers.ssm.com/so13/paper.ssfm?abstract_id=933712 [<https://perma.cc/82Z9-Y2C5>].

⁹⁹ See Ann E. Carlson, Meredith J. Hankins, Julia E. Stein, *Shifting Gears: The Federal Government’s Reversal on California’s Clean Air Act Waiver*, AM. CONST. SOC’Y. (Feb. 2019), <https://www.acslaw.org/wp-content/uploads/2019/02/CA-Car-Standards-IB-2019.pdf> [<https://perma.cc/C6R8-EXWA>].

¹⁰⁰ *California & the waiver: The Facts*, CAL. AIR RESOURCES BOARD (Sept.17, 2019) <https://ww2.arb.ca.gov/resources/fact-sheets/california-waiver-facts> [<https://perma.cc/797X-2GK5>].

¹⁰¹ See OR. REV. STAT. ANN. § 468A.363 (West 2017).

¹⁰² See *Small Engines in California*, CAL. AIR RESOURCES BOARD (Aug. 9, 2017), <https://ww2.arb.ca.gov/resources/fact-sheets/small-engines-california> [<https://perma.cc/DKJ8-3NZ2>].

¹⁰³ See William B. Johnson, Annotation, *Preemption of State and Local Regulation of Nonroad Engines or Vehicles by Section 209(e) of the Clean Air Act (42 USCA Section 7543(e))*, 54 AM. L.REP. FED. 2d 447 (2011); see also Erick Norem III, *An Electric Future for Today: An Analysis of Policy Options for State and Provincial Electric Vehicle Impact Standards to Expand Electric Vehicle Use*, 8 LA. ST. U. J. ENERGY L. & RESOURCES 127, 142 (2019), <https://digitalcommons.law.lsu.edu/cgi/viewcontent.cgi?article=1175&context=jelr> [<https://perma.cc/X94B-LYG3>] (showing how California can be a influential “first-player” in creating innovative environmental policies under their CAA waiver authority).

accelerate the transition from gas-powered to electric LGE.¹⁰⁴ Many of these programs are highly popular, with demand for incentives outpacing program limits.¹⁰⁵ In some cases states have also delegated some authority to implement these policies to local authorities responsible for managing air quality issues (“air quality districts”).¹⁰⁶

i. Arizona

Voluntary emissions reduction policy strategies like those in Arizona are one potential means for states to promote reduced emissions from gas-powered LGE. Arizona’s “Voluntary lawn and garden equipment emissions reduction program” helps reduce citizens’ retail costs of transitioning to electric LGE.¹⁰⁷ A statutory law in Arizona specifically empowers counties with at least 500,000 residents to adopt emissions reductions programs so long as such programs “provide for real and quantifiable emissions reductions.”¹⁰⁸ Participating counties must also submit annual progress reports of the cost-effectiveness of such programs.¹⁰⁹

In 2018, Maricopa County, Arizona, launched its “Mowing Down Pollution” program, which seeks to improve air quality by incentivizing residents to switch to electric LGE.¹¹⁰ To participate

¹⁰⁴ See *Modernizing the Electric Power System to Support the Development and Deployment of Increasingly Clean Technologies*, NAT’L ACADEMIC SCI. ENGINEERING MED. (2016), <https://www.nap.edu/read/21712/chapter/10> [<https://perma.cc/S6EU-H53N>].

¹⁰⁵ See Paul Hope, *Get a Discounted Mower at a Lawn Mower Exchange*, CONSUMER REP. (Mar. 24, 2017), <https://www.consumerreports.org/lawn-mowers-and-tractors/get-a-discounted-mower-at-a-lawn-mower-exchange/> [<https://perma.cc/DSQ2-QAW5>] (exchanging lawn mower program in San Diego, people began lining up at 4:30 a.m. in order to guarantee access to the purchase of a discounted electric mower.).

¹⁰⁶ See *Government Partnerships to Reduce Air Pollution*, ENVTL. PROTECTION AGENCY (Jan. 19, 2017), <https://www.epa.gov/clean-air-act-overview/government-partnerships-reduce-air-pollution> [<https://perma.cc/RV3S-VD7R>].

¹⁰⁷ Ark. CODE ANN. § 49-474.02 (West 2009) [<https://perma.cc/X3S3-JRDT>]; see also MARICOPA COUNTY RECEIVES 31 NATIONAL ACHIEVEMENT AWARDS (June 6, 2019), <https://www.maricopa.gov/CivicAlerts.aspx?AID=699> [<https://perma.cc/8LYF-TFUS>] (receiving a national achievement award for Maricopa County’s ‘Mowing Down Pollution’ program for increasing residents’ well-being and improving the use of technology to transform how the county does business).

¹⁰⁸ See ARK. CODE ANN. § 49-474.02(A) (West 2009).

¹⁰⁹ ARIZ. REV. STAT. § 49-474.02(G) (LexisNexis 2020).

¹¹⁰ See Maricopa Cnty. Air Quality Dep’t, *Mowing Down Pollution Program*, CLEAN AIR MAKE MORE, <https://cleanairmakemore.com/lawn/> [<https://perma.cc/B5KM-7QCY>] (last viewed Oct. 3, 2020) [hereinafter Maricopa Cnty. Air Quality Dep’t]; see also Cecilia Chan, *Residents warming to lawn mower exchange program*, AHWATUKEE FOOTHILLS NEWS, https://www.ahwatukee.com/news/article_ded8aa04-8f98-11e8-a0ff-

in the program, residents must submit a voucher application, donate their working, gas-powered LGE to the county government, and submit a verification form.¹¹¹ Once the process is completed, the applicant receives a \$150 voucher for an electric lawn mower or a fifty dollar voucher for other LGE.¹¹² The new LGE purchased must be for residential use, be zero-emission electric, cordless or corded, and if cordless, must include battery and charger.¹¹³ In its inception year, 894 old lawn mowers were turned in and 864 new lawn mowers were purchased through the program.¹¹⁴

ii. South Coast Air Quality Management District Programs

The South Coast Air Quality Management District (“SCAQMD”), a California state agency responsible for controlling air pollution in the greater Los Angeles area, has also introduced programs aimed at promoting the transition to electric LGE.¹¹⁵ SCAQMD’s residential “Electric Lawn Mower Rebate Program” offsets the cost of purchasing an electric lawn mower by allowing residents to turn in their old gasoline-powered machines in exchange for a rebate on the price of a new electric lawn mower.¹¹⁶ Although other air quality districts in the state offer rebates on other types of electric LGE, including leaf blowers, chain saws, hedge trimmers, and even additional batteries, the SCAQMD’s rebate program is limited to battery-powered lawn

9f26496e47ff.html [https://perma.cc/8K8L-AJCQ] (last viewed Oct. 3, 2020) (providing an approximation of the start date of the program).

¹¹¹ Maricopa Cnty. Air Quality Dep’t, *supra* note 110.

¹¹² *Id.*

¹¹³ *Id.*

¹¹⁴ Memorandum from Jon Sherrill on Meeting Notification and Transmittal of Tentative Agenda to Members of Maricopa Association of Governments Air Quality Technical Advisory Committee 7 (May 16, 2019), https://azmag.gov/Portals/0/Documents/MagContent/AQTAC_2019-05-23_Agenda.pdf [https://perma.cc/M9TK-XQ2T] (on file with Maricopa Association of Governments).

¹¹⁵ See *generally Frequently Asked General Questions*, S. COAST AIR QUALITY MGMT. DIST., <http://www.aqmd.gov/nav/about/frequently-asked-questions> [https://perma.cc/2MKS-65VG] (last viewed Oct. 5, 2020) (answering questions about the agency and their processes); *Climate Change*, S. COAST AIR QUALITY MGMT. DIST., <http://www.aqmd.gov/nav/about/initiatives/climate-change> [https://perma.cc/6SPY-ACEB] (last viewed Oct. 5, 2020) (outlining previous actions taken against climate change).

¹¹⁶ See *Electric Lawn and Garden Equipment*, S. COAST AIR QUALITY MGMT. DIST., <http://www.aqmd.gov/home/programs/community/detail?title=lawn-equipment> [https://perma.cc/UT7X-J397] (last viewed Oct. 3, 2020).

mowers.¹¹⁷ The participant must also intend to own and operate the new electric lawn mower within the district for a minimum of three years from the date of purchase.¹¹⁸

C. Limitations of Existing Policies

Although policies like those just described are a good start, they do not go nearly far enough in driving a nationwide transition to electric LGE. For example, although these local incentive programs help to increase demand for electric LGE, they do not require manufacturers to comply with any new targets or standards.¹¹⁹ Without any such mandates, there are minimal incentives for manufacturers to invest aggressively in new electric LGE technologies.¹²⁰ Of course, it is not possible for states or localities to impose manufacturing standards because federal law would rightly preempt any such rules to prevent unnecessary patchworks of state standards.¹²¹

Current policies also do not adequately deter new gas LGE purchases. Despite EPA findings revealing gas-powered LGE are a major source of toxic and carcinogenic emissions, annual sales of gas-powered LGE continue to soar.¹²² Moreover, those with new gas LGE products are deterred from transitioning to electric because they will face sunk costs from their gas equipment

¹¹⁷ Cal. Air Res. Board, *Zero-Emission Landscaping Equipment Incentive Programs*, STATE OF CAL., <https://ww2.arb.ca.gov/our-work/programs/zero-emission-landscaping-equipment/zero-emission-landscaping-equipment-incentive> [https://perma.cc/Z4W5-DFXP] (last viewed Oct. 3, 2020).

¹¹⁸ *Electric Lawn Mower Rebate Program*, S. COAST AIR QUALITY MGMT. DIST., <http://www.aqmd.gov/home/programs/community/electric-lawn-mower-rebate-program> [https://perma.cc/3F64-FASG] (last viewed Oct. 3, 2020).

¹¹⁹ See *Economic Incentives*, U.S. ENV'T PROT. AGENCY, <https://www.epa.gov/environmental-economics/economic-incentives> (last viewed Oct. 6, 2020) [https://perma.cc/48L8-62DK].

¹²⁰ Cf. ENV'T LINK, COMPARATIVE ASSESSMENT OF THE ENVIRONMENTAL PERFORMANCE OF SMALL ENGINES—MARINE OUTBOARDS AND PERSONAL WATERCRAFT 58 (Austral. Dep't. of the Env't & Water Res. ed., 2007), <https://ecoboats.com.au/wp-content/uploads/2018/09/Comparative-Assessment-Small-Marine-Engines.pdf> [https://perma.cc/HG2B-CY4K] (last viewed Jan. 20, 2021).

¹²¹ *Contra Note, Antitrust Federalism, Preemption, and Judge-Made Law*, 133 HARV. L. REV. 2557, 2578 (2020).

¹²² Rubenstein & Telford, *supra* note 11, at 11; *Small Gas Engines Market: Rising Trends with Top Countries Data, Technology and Business Outlook 2020 to 2026*, MARKETWATCH, <https://www.marketwatch.com/press-release/small-gas-engines-market-rising-trends-with-top-countries-data-technology-and-business-outlook-2020-to-2026-2020-09-30> (last viewed Oct. 6, 2020) [https://perma.cc/CQ9U-FLLQ].

purchase.¹²³ In the face of these challenge, the EPA has suggested increased cooperation between communities, government agencies and medical and scientific organizations to increase public awareness of gas-powered LGE.¹²⁴

There are some signs stronger cooperation among multiple levels of government could help to accelerate the transition to electric LGE.¹²⁵ For example, American Green Zone Alliance (“AGZA”), a California organization aiming to “kick gas off grass,” has helped local governments, commercial landscaping businesses, and residents in California transition from gas to electric operations for lawn care.¹²⁶ In summary, stronger and more coordinated policies at all levels of government are needed to effectively phase out gas-powered LGE use.

II. ACCELERATING THE TRANSITION TO ELECTRIC LAWN & GARDEN TOOLS

Given the many shortcomings of the nation’s existing policies surrounding LGE, there are ample opportunities to significantly improve them at all levels of government. This Section describes several actions federal, state, and local policymakers could take to facilitate a faster and more efficient transition to electric LGE. These recommendations are based in part on “environmental federalism” principles, which inform questions about the optimal balance between federal and local governance with respect to environmental policy.¹²⁷

“Classical” environmental federalism principles suggest the size of the geographic area affected by a specific pollution source should primarily determine the appropriate governmental level for responding to the pollution, based on the notion such level of governance is necessary to ensure internalization of the

¹²³ Cf. LISA WOOD ET AL., RECOVERY OF UTILITY FIXED COSTS: UTILITY, CONSUMER, ENVIRONMENTAL AND ECONOMIST PERSPECTIVES 11 (Future Elec. Util. Regul. ed., 2016).

¹²⁴ See Rubenstein & Telford, *supra* note 11, at 13.

¹²⁵ Cf. Daniel C. Esty & Damien Geradin, *Regulatory Co-Opetition*, 3 J. INT’L ECON. L. 235, 235 (2000).

¹²⁶ See *AGZA Services*, AM. GREEN ZONE ALL. <https://www.agza.net/services> [<https://perma.cc/3JFS-RXHW>] (last viewed Oct. 3, 2020) (empowering their clients to confidently transition to electric lawn and garden tools through informed decision-making).

¹²⁷ See David E. Adelman & Kirsten H. Engel, *Adaptive Federalism: The Case Against Reallocating Environmental Regulatory Authority*, 92 MINN. L. REV. 1796, 1803 (2008).

costs of pollution within a given area.¹²⁸ Consistent with this idea, much of the nation's environmental regulation has historically resided at the federal level, with some limited overlap between individual states and the federal government.¹²⁹

More recently, many states and local governments have taken on more active roles in governing national or even international scale environmental challenges, such as climate change.¹³⁰ This trend is consistent with an increasingly “adaptive” federalism approach considering each state's distinct socioeconomic, political, and environmental characteristics to help orchestrate more optimal use of multiple levels of government to address environmental issues.¹³¹ It also reflects what some scholars have called “dynamic federalism,” which can help states to innovate in environmental policy within certain constraints by providing a clearer framework for the interplay between federal and state actors.¹³²

Based on the federalism concepts discussed above, the federal government is likely best suited to help address national and global externality problems associated with gas-powered LGE through federal-level policies, such as income tax credits. The federal government is also better situated to establish and enforce nationwide LGE manufacturing standards capable of preventing an unworkable patchwork of state standards.¹³³

¹²⁸ See *id.* at 1802; Henry R. Butler & Jonathan R. Macey, *Externalities and The Matching Principle: The Case for Reallocating Environmental Regulatory Authority*, 14 YALE L. & POL'Y REV. 23, 36 (1996).

¹²⁹ See Benjamin K. Sovacool, *The Best of Both Worlds: Environmental Federalism and the Need for Federal Action on Renewable Energy and Climate Change*, 27 STAN. ENVTL. L.J. 397, 409 (2008) (characterizing environmental policy beginning post-World War II era as a time of “creeping federalization”).

¹³⁰ See Adelman & Engel, *supra* note 127, at 1799 (adopting the “adaptive” environmentalism approach because environmental problems are multifaceted and originate from more than one level of government); see also Kirsten H. Engel, *Democratic Environmental Experimentalism*, 35 UCLA J. ENV'T L. & POL'Y 57, 57–63 (2017) (recognizing regulatory gaps as a result of the downfalls static, traditional environmentalism federalism and its potential to stifle innovation at state and local levels).

¹³¹ See generally *id.*

¹³² See Kirsten H. Engel, *Harnessing the Benefits of Dynamic Federalism in Environmental Law*, 56 EMORY L.J. 159, 162 (2006).

¹³³ See, e.g., E. Donald Elliott et al., *Toward a Theory of Statutory Evolution: The Federalization of Environmental Law*, 1 J.L. ECON. & ORG. 313, 330–31 (1985) (explaining federal air quality legislation is the result in part of industry efforts to replace inconsistent state laws with a uniform federal law); Andrew P. Morris & Susan E. Dudley, *Defining What to Regulate: Silica and the Problem of Regulatory Categorization*, 58 ADMIN. L. REV. 269, 324 (2006) (referring to same phenomenon with respect to worker safety rules); Baher Azmy, *Squaring the Predatory Lending Circle: A Case for States as*

States and local governments are well-positioned to play other vital roles in LGE-related policy, helping to tailor approaches to account for wide variations in economic, political, and geographic characteristics across jurisdictions. State and local governments can also be effective at advancing policy goals when the federal government encounters political gridlock.¹³⁴ For instance, in states and municipalities where local air quality issues are of particular concern, state or local rebate and voucher programs for electric LGE could be an appropriate and effective means of supplementing federal incentive policies. Many states and local governments may likewise be well-positioned to work with utility companies to better educate citizens and to combat path dependence problems otherwise slowing the transition to electric LGE. The materials that follow describe those potential policy strategies for promoting electric LGE suitable at each primary government level.

A. Potential Federal LGE Electrification Strategies

Stronger federal-level policies could do much to accelerate the electrification of LGE in the U.S. The following subsections describe two possible federal-level policy strategies capable of catalyzing widespread adoption of electric LGE: increasingly stricter nationwide LGE emissions standards and new federal tax credits for electric LGE purchasers.

i. New EPA “Phase 4” Emissions Standards for LGE

The most direct way the federal government could facilitate a faster transition to electric LGE would be to impose increasingly stringent federal manufacturing standards. Specifically, the EPA could impose new “Phase 4” emission manufacturing standards requiring manufacturers to gradually phase out their manufacture and sale of gas-powered LGE, and to steadily replace their existing gas-powered product lines with electric LGE products.

Laboratories of Experimentation, 57 FLA. L. REV. 295, 401 n.545 (2005) (same with respect to predatory lending laws).

¹³⁴ See NATIONAL CONFERENCE OF STATE LEGISLATURES, *State Legislative Policymaking in an Age of Political Polarization*, https://www.ncsl.org/Portals/1/HTML_LargeReports/Partisanship_1.htm [<https://perma.cc/3NGM-NJCG>] (last viewed Jan. 20, 2021).

Federal manufacturing standards are a sensible means of reducing nationwide emissions from LGE. For example, uniform federal standards prevent manufacturers from attempting to comply with a patchwork of different standards across state or local jurisdictions.¹³⁵ By structuring such emission standards to become increasingly stringent over time, the EPA could give manufacturers sufficient time and flexibility to transition their products lines. For many manufacturers, it will be less costly to respond to such new regulations by investing in and expanding electric fleets since electricity-based technologies are often already commercially available.¹³⁶ At the same time, imposing emissions standards that ratchet up over time gives manufacturers some flexibility by allowing them to continue producing some gas-powered products when they cannot immediately switch particular product lines to electric designs.¹³⁷

The structure of such new nationwide LGE emissions standards could resemble standards used in the Energy Independence and Security Act of 2007 (“EISA”), which phased out incandescent lightbulbs in the U.S.¹³⁸ The EISA did not flatly ban the manufacture, sale, use, or purchase of incandescent bulbs.¹³⁹ Instead, the EISA required approximately twenty-five percent greater efficiency for household light bulbs over time.¹⁴⁰ In a similar way, the proposed “Phase 4” standards for LGE could be structured to ensure manufacturers are incentivized to invest in electric LGE technologies but could still sell some gas-powered products, so long as their aggregate product lines comply with new standards. These emission manufacturing standards will also promote local clean air goals within communities because they will compel the LGE industry to spend the necessary time and resources to develop innovative technology for electric LGE technology.¹⁴¹

¹³⁵ See Joshua D. Sarnoff, *The Continuing Imperative (But Only from a National Perspective) For Federal Environmental Protection*, 7 DUKE ENV'T L. & POL'Y F. 225, 252–53 (1997).

¹³⁶ See *id.* at 252.

¹³⁷ See Ashley Morris Bale, *The Newest Frontier in Motor Vehicle Emission Control: The Clean Fuel Vehicle*, 15 VA. ENV'T L.J. 213, 219 (1996).

¹³⁸ See United States Environmental Protection Agency, *How the Energy Independence and Security Act of 2007 Affects Light Bulbs*, U.S. ENV'T PROT. AGENCY, <https://www.epa.gov/cfl/how-energy-independence-and-security-act-2007-affects-light-bulbs> [https://perma.cc/8FD3-XPES] (last viewed Jan. 20, 2021).

¹³⁹ *Id.*

¹⁴⁰ *Id.*

¹⁴¹ See Sarnoff, *supra* note 135, at 298, 302 (setting motor vehicle emission

ii. Federal Tax Credit

While stricter manufacturing standards could help drive electrification on the supply side of the LGE market, federal tax credits could increase consumer demand for those new electric products. In 2009, the United States House of Representatives proposed the “Greener Gardens Act,” which would have offered Americans a twenty-five percent tax credit on purchases of LGE powered by electricity or other qualifying alternative fuels.¹⁴² Although the “Greener Gardens Act” never became law,¹⁴³ the potential benefits of such a tax credit program have arguably never been greater.

A federal tax credit for purchases of electric LGE is an appealing policy strategy in part because of the nation’s growing reliance on clean and renewable energy sources.¹⁴⁴ Tax credits have historically been successful in fostering adoption and innovation for clean energy technologies.¹⁴⁵ Furthermore, tax credits for electric LGE purchases are likely to have comparable success because the technologies they would promote have similarly already been commercialized but have yet to be widely adopted and are thus poised to benefit greatly from further innovation and production economies of scale.¹⁴⁶

Ideally, any such new federal tax credit for electric LGE would be structured to be transferrable between buyer and seller so retail consumers reap immediate price discounts.¹⁴⁷ A tax structure whereby purchasers can transfer their tax credit to their LGE dealers at the time of purchase effectively makes the tax credit a point-of-sale rebate for the purchaser.¹⁴⁸ Under this

control policies at currently unattainable levels but allowing manufacturers to comply through a lead-in time period).

¹⁴² See Greener Gardens Act 5 of 2009, H.R. 3530, 111th Cong. (2009).

¹⁴³ *Id.*

¹⁴⁴ See Troy A. Rule, RENEWABLE ENERGY LAW, POLICY, AND PRACTICE 64 (West 2018).

¹⁴⁵ See David Hart & Elizabeth Noll, *Less Certain Than Death: Using Tax Incentives to Drive Clean Energy Innovation*, INFORMATION TECHNOLOGY & INNOVATION FOUNDATION (2019), <https://itif.org/publications/2019/12/02/less-certain-death-using-tax-incentives-drive-clean-energy-innovation> [https://perma.cc/J6MD-N9R2].

¹⁴⁶ *Id.*

¹⁴⁷ See Electric Vehicle Deployment Act of 2010, S. 3442, 111th Cong. § 4 (2010) (proposing to enact a transferrable tax credit to national deployment communities for electric vehicles).

¹⁴⁸ See Electrification Coalition, *The Role of Tax Credits in the Electric Vehicle*

scheme, consumers do not have to wait to file annual tax returns to receive the direct financial benefits of participating in the tax credit program. Consumers tend to respond more strongly to instant cash discounts instead of delayed tax returns.¹⁴⁹

Adopting stricter federal emissions standards and creating a new federal tax credit program would be a powerful means of accelerating the nationwide transition to electric LGE, yielding benefits likely outweighing the costs. Such policy approaches would likely be superior to alternatives, such as federal bans on gas-powered LGE, federally funded research grants, or tax incentives for private research.

Among other things, the EPA's longstanding approach to emissions standards for light-duty vehicles has been to impose them based on fleet-wide averages, so extending this approach to LGE would likely be similarly feasible and would not create enormous new administrative burdens.¹⁵⁰ A policy of gradually-increasing emissions standards would also minimize the adverse impacts of phasing out gas-powered LGE for industry stakeholders and disadvantaged communities, both of which will have to overcome heavy path-dependence after decades of under-regulation.¹⁵¹ Moreover, the federal government's prior successes in funded renewable energy, energy storage, energy efficiency, and other sustainable energy innovations may help create spillover effects further supporting the more rapid development of an electric LGE industry.

Deployment Act (2018), https://www.electrificationcoalition.org/wp-content/uploads/2018/07/Need_for_Transferable_Credits.pdf. [<https://perma.cc/DWL2-Y79G>].

¹⁴⁹ See Kelly Gallagher, Erich Muehlegger, Giving Green to Get Green: Incentives and Consumer Adoption of Hybrid Electric Vehicle Technology, Harv. John F. Kennedy School of Gov't, (Feb. 1, 2008) (Faculty Working Paper) (copyright belongs to the author(s)).

¹⁵⁰ See U.S. EPA, *supra* note 82.

¹⁵¹ See Christopher David Ruiz Cameron, *The Rakes of Wrath: Urban Agricultural Workers and the Struggle Against Los Angeles's Ban on Gas-Powered Leaf Blowers*, 33 U.C. DAVIS L. REV. 1087, 1089–90 (2000) (describing how Los Angeles's ban on leaf blowers oppressed Latino gardeners); see also Butler & Macey *supra* note 129, at 426 (supporting the idea that national emission manufacturing standards can assist in guaranteeing a minimum standard of environmental quality for *all* Americans) (italics added).

iii. State and Local Policy Options

In addition to federal government strategies, state and local governments could also play a key role in accelerating the nation's transition to electric LGE. Although federal laws have historically been a driving force behind environmental policy in the U.S., state and local government officials are better informed about the unique characteristics and needs of citizens within their jurisdictions. States and municipalities, based on their familiarity and locality, can likely disseminate information efficiently to citizens about electric LGE and the incentives available.¹⁵² Thus, local government can be helpful in better tailoring LGE-related policies to local needs.¹⁵³

iv. Rebate and Voucher Programs

In states such as Arizona, where gas-powered LGE can uniquely harm air quality, rebate or voucher programs, like those offered in parts of Arizona, can be powerful means for state or local governments to further motivate citizens to purchase electric LGE products.¹⁵⁴ Such layering of incentives at the federal and local levels is consistent with adaptive environmental federalism, which calls for greater local involvement when localized information and tailoring is important to achieving an efficient solution.¹⁵⁵

A few municipalities around the country have previously implemented rebate or voucher programs for electric LGE, but often only for a limited time or with small amounts of available inventory.¹⁵⁶ If such programs were expanded and subsidized with state funds, they could potentially have transformative

¹⁵² See generally *id.*

¹⁵³ See Katrina F. Kuh, *Using Local Knowledge to Shrink the Individual Carbon Footprint*, 37 HOFSTRA. L. REV. 923 (2009) (noting that local governments are “uniquely positioned to influence citizen behaviors—their transportation options, energy consumption patterns and general consumer decisions”).

¹⁵⁴ See Norem III, *supra* note 103.

¹⁵⁵ See Kuh, *supra* note 153, at 930–31 (describing the need for local involvement to capture as many costs and benefits of an environmental problem within a particular geographic area).

¹⁵⁶ See Utah Dept. of Env'tl Quality, *CARROT Program*, Utah Division of Air Quality, (last updated Sept. 9, 2020, 9:33 AM) (describing a temporary state initiative in Utah to reduce emissions through an exchange of lawn equipment for rebates).

effects in states where electric LGE offer the greatest benefits. Properly structured incentive programs can also effectively assist the removal of older, dirtier, and environmentally harmful equipment. To drive greater citizen participation, such programs should be year-round rather than weekend-only events and all buyers and sellers of electric LGE within the jurisdiction should be eligible to participate.¹⁵⁷

State and local programs promoting electric LGE may also be more effective at connecting with citizens and educating them on the advantages of electric LGE. Policies aimed at incentivizing retail consumers to transition from gas to electric LGE are effective only to the extent consumers know about the existence of such policies. There is widespread evidence members of the public want more information about environmental conditions and want more and earlier opportunities to participate in environmental decisions.¹⁵⁸ Local governments often play vital roles in this process, connecting market stakeholders with environmental stakeholders and citizens.¹⁵⁹

v. Utility-Sponsored Partnerships

Some state and local governments may also benefit from partnering with electric utilities in LGE electrification efforts. From a utility's perspective, working with governmental officials to promote the adoption of electric LGE may provide a useful means of improving relationships with retail customers and involve them in environment-related decisions.¹⁶⁰ Because utilities have regular contact with virtually every household in their territories, they are also often capable of distributing information through mail or online platforms alongside monthly

¹⁵⁷ Maricopa Cnty. Air Quality Dep't, *supra* note 110 (describing a voucher program in Maricopa County (Arizona) that can only be claimed at local Home Depot locations).

¹⁵⁸ See LeRoy Paddock, *Green Governance: Building the Competencies Necessary for Effective Management*, 38 ENVTL. L.R. 10609, 10639-40 (2008).

¹⁵⁹ See Melissa Birchard, *What is Grid Modernization? An Explainer*, CONSERVATIVE LAW FOUNDATION (Oct. 27, 2017), <https://www.clf.org/blog/what-is-grid-modernization/> [<https://perma.cc/EWV9-MHPC>] (discussing 21st century trends and local roles in the future of electricity markets).

¹⁶⁰ See Shelley Welton, *Clean Electrification*, 88 U. COLO. L. REV. 571, 642 (2017); See also, Angelina Lian, *Shedding Light: The Role of Public Utility Commissions in Encouraging Adoption of Energy Efficient Lighting by Low-Income Households*, 38 COLUM. J. ENVTL. L. 333, 360 (2013) (recognizing that utilities can use their "gatekeeper" role to induce widespread adoption of new practices and more efficient equipment).

electric bill information at a very low cost. Partnering with governments to distribute information about electric LGE benefits may likewise help some utilities to build goodwill with customers by demonstrating a commitment to environmental protection.

Utilities may likewise view more widespread adoption of electric LGE as economically beneficial because of its potential to increase the demand for retail electricity in an era when distributed renewable energy technologies are gradually reducing aggregate demand for grid-delivered electric power.¹⁶¹ As the nation's century-old public utility regulatory model faces growing challenges from this decrease in demand, the transition to electric LGE presents an opportunity to slow the trend.¹⁶² Altogether, utility partnerships can have a major impact on consumers' knowledge, access, and opportunity to participate in local programs.

CONCLUSION

In today's age of sleek and powerful electric vehicles, it is no longer justifiable for low-tech, gas-powered lawn and garden tools to continue polluting the atmosphere. Modern, electric LGE technologies are cost-effective, efficient, and often as powerful as their gas-powered counterparts yet produce no direct emissions in American backyards.¹⁶³ And as the nation's electric energy mix grows ever cleaner and more renewable, the case for electrifying LGE only becomes stronger.¹⁶⁴

Most existing policies are not designed to fully address the externality problems associated with modern uses of gas-powered LGE.¹⁶⁵ Purchasers and users of gas-powered LGE do not

¹⁶¹ See Jim Rossi & Michael Vandenbergh, *Good for You, Bad for Us: The Financial Disincentive for Net Demand Reduction*, 65 VAND. L. REV. 1527 (2012) (asserting that the use of information and other nonintrusive interventions could lead to reduced carbon emissions at the household level because retail electricity distributors regularly interact with customers, and control much of the flow of information to and from households).

¹⁶² See Alexandra B. Klass, *Public Utilities and Transportation Electrification*, 104 IOWA L. REV. 545, 569–71 (2019) (explaining how energy efficiency investments and distributed energy systems have imposed downward pressure on utility revenues and that mass adoption of electric vehicles can significantly increase demand for electricity).

¹⁶³ Hope, *supra* note 31; Pincher, *supra* note 73.

¹⁶⁴ Nat'l Renewable Energy Lab'y, *supra* note 59.

¹⁶⁵ Dekeyan, *supra* note 61; Silverstein, *supra* note 53; ENV'T LINK, *supra* note

internalize all of the costs of their actions, and those who invest in electric LGE likewise do not internalize all of the broader social benefits of their actions.¹⁶⁶ In light of these market failures, more aggressive policies are needed to promote optimal levels of electric LGE investment and use.

Fortunately, there are policy strategies available at all levels of government capable of accelerating the nation's transition to electric LGE.¹⁶⁷ At the federal level, a new set of "Phase 4" EPA regulations imposing increasingly strict emissions standards for LGE over time would compel manufacturers to steadily reduce emissions on gas-powered LGE models or rapidly switch to manufacturing electric equipment. A new federal tax credit for purchases of electric LGE paired with those standards would correspondingly help to drive increases in retail demand for new electric LGE products, mitigating some of the positive externality problems associated with electric LGE.

In states and municipalities with the most severe air quality challenges due to gas-powered LGE, new or expanded rebate or voucher programs could supplement federal incentives and drive even more rapid transitions to electric LGE products.¹⁶⁸ Working with utilities that are also eager to build goodwill with customers and increase electricity demand within their territories, state and local governments are well-situated to educate the public about the environmental and health costs of gas-powered LGE as well as the potential benefits of going electric.¹⁶⁹

By leveraging readily available technologies, it is entirely possible for Americans to enjoy neatly-trimmed lawns while breathing clean, neighborhood air. Policymakers at all levels of government must adopt this vision and take simple steps to help the country build a fleet of lawn and garden tools powered mostly by wind and sun.

¹⁶⁶ See California Air Resources Board, *supra* note 56; see also ENV'T LINK, *supra* note 120.

¹⁶⁷ Engel, *supra* note 98.

¹⁶⁸ Norem III, *supra* note 103.

¹⁶⁹ Birchard, *supra* note 159.