

May 8, 2024

David Dickinson  
Attorney/Advisor  
United States Environmental Protection Agency  
Office of Transportation and Air Quality  
Mail Code 6405J  
1200 Pennsylvania Avenue, N.W.  
Washington, D.C. 20460  
[dickinson.david@epa.gov](mailto:dickinson.david@epa.gov)

RE: Supplemental Comment in Support of the Request for Authorization Pursuant to Clean Air Act Section 209(e) for California's 2016 and 2021 Amendments to California's Small Off-Road Engine Regulations (Docket ID: EPA-HQ-OAR-2023-0151)

Dear Mr. Dickinson:

I submit these supplemental comments in support of the request by the California Air Resources Board (CARB) for authorization under Clean Air Act section 209(e) for the addition to the State's program of its 2016 and 2021 amendments to California's small off-road engine (commonly referred to as SORE) regulations. These regulations establish emission standards and other requirements for nonroad spark-ignition engines rated at or below 19 kilowatts (kW). Contrary to the comments opposing CARB's request, including in other comments following the close of the comment period, the information below reinforces that California is entitled to authorization from the U.S. Environmental Protection Agency (EPA) for the inclusion of its SORE regulations. Since CARB adopted the SORE regulations, the regulated industry has responded and innovated to introduce additional products that meet the standards, removing any question of their feasibility. We encourage EPA to quickly grant the requested authorization.

## I. Introduction

On December 22, 2022, in light of the 2016 and 2021 amendments to its SORE regulations, the California Air Resources Board (CARB) submitted its request for authorization to EPA pursuant to section 209(e)(2) of the Clean Air Act. As part of its ongoing efforts to reduce air pollution from this category of equipment, CARB has continued to monitor the characteristics of zero-emission equipment (ZEE) products presently available to ensure it has continuously updated information regarding the technical and economic feasibility of the regulations that CARB adopted in December 2021 (2021 Amendments), the safety and durability of equipment in this category, and the availability of incentives for ZEE.

CARB presents to EPA the latest information available on the progress of the industry in meeting the amended requirements in the SORE regulations. The three attached exhibits

update the information CARB provided in its authorization request to EPA and the analysis performed during CARB's 2021 rulemaking.

Exhibit A is an updated table of performance specifications for currently available ZEE intended for residential and commercial use. This information builds on the technological and economic analysis done during the 2021 rulemaking. This table shows marked improvement in the availability of equipment from what was provided in CARB's request for authorization of the amendments.

CARB's direct responses to the comments and questions that EPA received during the hearing are attached to this document as Exhibit B. With respect to two particular categories of equipment, larger pressure washers and portable generators, CARB determined during the rulemaking process that additional time is necessary for manufacturers to develop and implement zero-emission technology. For these categories, zero-emission standards have longer lead time and apply beginning in model year (MY) 2028. CARB staff is in the process of conducting its technological review to provide an update to the Board prior to the implementation of the MY 2028 zero-emission standards.

Attached as Exhibit C is a spreadsheet, updated to March 2024, summarizing the generators and pressure washers that have already certified to the more stringent MY 2024 standards. This shows even these standards are feasible in the time provided.

Overall, the supplemental information shows CARB's technological feasibility predictions with respect to market development and reduced cost over time in the Initial Statement of Reasons (*ISOR*) were conservative. Reality has exceeded our projections in key areas.

The SORE regulations provide engine and equipment manufacturers with many options to comply. Equipment manufacturers may choose to convert existing equipment models to ZEE, introduce new models of ZEE, introduce lower-emitting engines, or use emission credits to offset the emissions from their engines. Also, entities that specialize in emergency response may purchase emergency equipment powered by a non-California certified engine when such equipment with a California-certified engine or zero-emission version is not available to meet their needs for emergency use. As an interim option until EPA grants the requested authorization, CARB has also allowed manufacturers to obtain "limited-term Executive Orders" (limited term EOs). These limited-term EOs allow manufacturers to certify new MY 2024 engines to 2023 standards with the understanding that upon published authorization by EPA, these limited-term EOs expire, and the engines would no longer be eligible for sale in California. This has led to some questions, as reflected in recent comment letters from stakeholders, about the status of CARB's regulations. CARB is not enforcing its regulation retroactively nor is it preventing adequate lead time for compliance. These concerns will also be addressed below, in Section X, "CARB's Limited-Term EO Program Does Not Retroactively Enforce the SORE Regulations nor does it Reduce Lead Time to Comply."

In response to comments and concerns about battery safety, it is important to recognize that CARB's SORE regulations apply to manufacturers producing new engines and do not

regulate all aspects of battery use and performance. Non-air quality agencies and other entities (e.g., Occupational Safety and Health Administration, U.S. Consumer Product Safety Commission, California Department of Toxic Substances Control, National Fire Protection Association, U.S. Department of Transportation) focus on occupational and fire safety for engines, fuel, and batteries, and administer requirements for battery safety. These concerns are properly addressed by those entities and their programs and are outside of the scope of EPA's review of an authorization request.

The purpose of the 2021 Amendments to CARB's SORE regulations is to meet California's public health and climate protection obligations, including the expected emission reductions in the 2016 State Strategy for the State Implementation Plan, requirements to reduce climate-damaging greenhouse gas (GHG) emissions, and the goals of Governor Newsom's Executive Order N-79-20, issued September 23, 2020. In addition, the 2021 Amendments comply with the California Assembly Bill 1346 (AB 1346, stats. 2021, ch. 753) requirement to prohibit engine exhaust and evaporative emissions from new small off-road engines. Statewide, more than 28 million Californians live in nonattainment areas for ozone and PM<sub>2.5</sub> (particulate matter with a diameter of 2.5 micrometers or smaller).<sup>1</sup> Requirements to eliminate emissions from small off-road equipment are a necessary part of California's larger program to attain the National Ambient Air Quality Standards, reduce harmful greenhouse gas emissions, and protect the health of all California residents and the environment of the state.

## II. CARB's Response to Technical Feasibility Concerns

During the comment period on CARB's authorization request, EPA received comments challenging the technical feasibility of the SORE regulations. To assist EPA in responding to these comments, CARB notes that its staff evaluated SORE equipment and ZEE for residential and professional users. During the 2021 rulemaking, CARB evaluated the nine most common types of small off-road equipment: chainsaws, portable generators, lawn mowers, leaf blowers, corded pressure washers, pumps, riding mowers, snowblowers, and trimmers. These make up 98% of residential equipment and 91% of professional equipment that are impacted by the 2021 Amendments.<sup>2</sup> Exhibit A includes these nine most common equipment types referenced in the *ISOR*, plus several additional types: bunker rakes, skid steers, sweepers, pole saws, edgers, brush cutters, and riding garden tractors. The technical feasibility analysis during 2021 rulemaking therefore extensively represents the market of available technologies and their practical feasibility.

---

<sup>1</sup> California Air Resources Board. "2020 Mobile Source Strategy." 2021.

[https://ww2.arb.ca.gov/sites/default/files/2021-12/2020\\_Mobile\\_Source\\_Strategy.pdf](https://ww2.arb.ca.gov/sites/default/files/2021-12/2020_Mobile_Source_Strategy.pdf)

<sup>2</sup> California Air Resources Board. "2020 Emissions Model for Small Off-Road Engines - SORE2020." 2020.

[https://ww2.arb.ca.gov/sites/default/files/2020-](https://ww2.arb.ca.gov/sites/default/files/2020-09/SORE2020_Technical_Documentation_2020_09_09_Final_Cleaned_ADA.pdf)

[09/SORE2020\\_Technical\\_Documentation\\_2020\\_09\\_09\\_Final\\_Cleaned\\_ADA.pdf](https://ww2.arb.ca.gov/sites/default/files/2020-09/SORE2020_Technical_Documentation_2020_09_09_Final_Cleaned_ADA.pdf)

Although the analysis includes snowblowers, snowblowers are not required to certify to, or comply with, the evaporative or hydrocarbon (HC) + nitrogen oxides (NO<sub>x</sub>) exhaust emission standards as set out in the regulations. They are only required to meet the carbon monoxide (CO) emission standards. The CO emission standards have not changed from preexisting emission standards, except for engines with displacement greater than 825 cubic centimeters (cc). Nevertheless, ZEE snowblowers are in production, as noted in Exhibit A, underscoring the feasibility of these standards for equipment in this category of similar size and performance.

CARB's *ISOR* Chapter I.E. discusses the technological feasibility and compares internal combustion (I.C.) powered SORE and ZEE performance characteristics, operational differences, and equipment lifetimes. When comparing I.C. SORE equipment to ZEE,<sup>3</sup> an important aspect to consider is that gasoline engines require more energy to do useful work due to the energy losses of combustion through heat, friction, and the inability to recover energy. ZEE generally has greater torque at low speeds and delivers more energy from their power source for useful work. Therefore, when comparing I.C. SORE to ZEE, it is important to consider that ZEE may not need the same power rating as SORE equipment to perform the same work and functions. Advances in battery technology have alleviated power drops as the end of a charge cycle approaches and increased the run times.<sup>4</sup> Commercial landscapers have substantiated that ZEE has enough power to do the job through survey responses and market behavior (including the increased demand for incentives covered in section III of this document) with equipment at a lower power rating than combustion counterparts. Thus, it is inappropriate to conclude that ZEE is not readily available based on comparisons to the power rating of combustion equipment.

As explained in *ISOR* sections I.E and II.A and in sections II.A.1.e and II.A.2.d of the *FSOR*, the 2021 Amendments include a longer compliance timeframe for equipment categories that faced greater challenges meeting zero-emission requirements. This left more time for manufacturers of zero-emission generators and pressure washers to further develop the markets.

In response to concerns about the ability of ZEE generators to power homes for extended periods, CARB notes that the SORE regulations do not apply to stationary generators, such as those permanently installed outside of homes for extended emergency use. CARB also notes that using I.C. SORE generators for home back-up power can result in injuries and

---

<sup>3</sup> Stihl. "How Your Business Can Save By Switching To Battery Power." Accessed on March 27, 2024. <https://www.stihlusa.com/tools-calculators/battery-power-savings-calculator/>

<sup>4</sup> Stihl. "Can Battery Live UP to the Legacy?" Accessed on March 27, 2024. <https://www.stihlusa.com/guides-projects/a/why-your-landscaping-crew-should-switch-to-battery/>

deaths from carbon monoxide poisoning.<sup>5,6</sup> There are ZEE alternative options capable of meeting the need to provide short-term emergency back-up power for essential home needs. For example, EcoFlow offers the DELTA Pro generator that provides 3.6 kWh battery capacity and can be expanded up to 25 kWh with battery expansion packs. At the lowest battery capacity, it can power a refrigerator for one to two days; at the highest capacity, it can power a refrigerator for 14 days. With a 5-year warranty, battery life is expected to be 6,500 cycles to 50% of the initial capacity or 3,500 cycles to 80% capacity.<sup>7</sup>

The availability of commercial ZEE pressure washers has increased since 2021 as shown in Exhibit A. One example is the Tuffy pressure washer, which has a 4-gallon-per-minute flow rate, operating at a pressure of 4,000 pounds per square inch, and lasts 6.5 hours on a full charge. With these new products coming to the market and manufacturers showing interest and ability to provide more products, CARB staff expect other manufacturers to start producing more options, which will drive down upfront costs.<sup>8</sup>

The increase in the use of brushless electric motors has led to a significant increase in the capabilities and performance of ZEE, which has led to a significant increase in ZEE product development over the years. As stated recently by Consumer Reports, "Every year we test more battery tools, and every year we find fewer reasons to recommend buying gas tools."<sup>9</sup>

While SORE perform various tasks, they are not limited to using engines as their power units nor are they necessarily reliant on new technology for each equipment type to meet the new standards. The technological feasibility of the SORE regulations does not depend on manufacturers having already produced ZEE versions of every type since many power units may be utilized on different equipment types. Just as equipment manufacturers install similar engines in many equipment types, they may choose to install similar zero-emission power units in many equipment types without the need to develop new technology.

---

<sup>5</sup> United States Consumer Product Safety Commission. "Fatal Incidents Associated with Non-Fire Carbon Monoxide Poisoning from Engine-Driven Generators and Other Engine-Driven Tools, 2012-2022." 2023. <https://www.cpsc.gov/s3fs-public/Generators-and-OEDT-CO-Poisoning-Fatalities-Report-2023-final.pdf?VersionId=4OFh0HpOo9Qm.UhT2hGJHFdLPJTyzK7E>

<sup>6</sup> United States Consumer Product Safety Commission. "Non-Fire Carbon Monoxide Deaths Associated with the Use of Consumer Products 2020 Annual Estimates." 2024. [https://www.cpsc.gov/s3fs-public/Non-Fire-Carbon-Monoxide-Deaths-Associated-with-the-Use-of-Consumer-Products-2020-Annual-Estimates.pdf?VersionId=mQ7JXFB\\_ec1GKIFgVQkLYCwN5\\_fybL4S](https://www.cpsc.gov/s3fs-public/Non-Fire-Carbon-Monoxide-Deaths-Associated-with-the-Use-of-Consumer-Products-2020-Annual-Estimates.pdf?VersionId=mQ7JXFB_ec1GKIFgVQkLYCwN5_fybL4S)

<sup>7</sup> EcoFlow. "DELTA Pro: The portable home battery." Accessed on March 27, 2024. <https://www.ecoflow.com/us/delta-pro-portable-power-station>

<sup>8</sup> Tuffy Cleaning Systems. "Zero Emissions Battery Powered Commercial Pressure Washer." Accessed on March 27, 2024. <https://tuffycleaningsystems.com/tuffy-cleaning-systems>

<sup>9</sup> Consumer Reports. "5 Green Reasons to Choose Battery-Powered Lawn Tools." 2023. Accessed on March 27, 2024. <https://www.consumerreports.org/home-garden/reasons-to-choose-battery-powered-lawn-tools-a1182121491/>

### III. CARB's Response to Cost Feasibility Concerns

Section 209(e)(2) of the Clean Air Act directs the Administrator of EPA to grant an authorization to California for emissions standards and other requirements for nonroad engines if California determines that the state's standards will be, in the aggregate, at least as protective of public health and welfare as applicable federal standards, unless he finds that: (1) the protectiveness finding of the state is arbitrary and capricious; (2) California does not need separate state standards to meet compelling and extraordinary conditions; or (3) the state standards and accompanying enforcement procedures are not consistent with section 209 of the Act.<sup>10</sup>

In its *209(e) Final Rule*, EPA interpreted section 209(e)(2)(A)(iii) to require that California's standards and accompanying enforcement provisions must also be consistent with sections 209(a), 209(e)(1), and 209(b)(1)(C).<sup>11</sup> As the Administrator has stated:

"In order to be consistent with section 209(a), California's nonroad standards and enforcement procedures must not apply to new motor vehicles or new motor vehicle engines. To be consistent with section 209(e)(1), California's nonroad standards and enforcement procedures must not attempt to regulate engine categories that are permanently preempted from state regulation."<sup>12</sup>

"The Agency has decided...that it is reasonable and effects Congressional intent to interpret "consistent with this section" to include all of section 209, including section 209(b)(1)(C). Hence, EPA believes it should review nonroad authorization requests under the same "consistency" criteria that are applied to motor vehicle waiver requests. Under section 209(b)(1)(C), the Administrator shall not grant California's motor vehicle waiver if she finds that California standards and accompanying procedures are not consistent with section 202(a)."<sup>13</sup>

Consistency with section 202(a) "relates in relevant part to technological feasibility and to federal certification requirements."<sup>14</sup> "The 'technological feasibility' component of section 202(a) obligates California to allow sufficient lead time to permit manufacturers to develop and apply the necessary technology."<sup>15</sup> "The federal certification component

---

<sup>10</sup> 42 U.S.C. 7543(e)(2)(A)(i)-(iii); 82 Fed. Reg. 6,525, 6,526 (Jan. 19, 2017).

<sup>11</sup> 59 Fed. Reg. 36,969, 36,983 (July 20, 1994).

<sup>12</sup> 87 Fed. Reg. 35,675, 35,767 (2022).

<sup>13</sup> 59 Fed. Reg. 36,969, 36,983 (1994).

<sup>14</sup> *Motor & Equip. Mfrs. Ass'n v. Nichols*, 142 F.3d 449, 463 (D.C. Cir. 1998) (quoting *Ford Motor Co. v. EPA*, 606 F.2d 1293, 1296 n. 17 (D.C.Cir.1979)).

<sup>15</sup> *Id.*

ensures that the Federal and California test procedures do not ‘impose inconsistent certification requirements.’”<sup>16</sup>

As section 202(a) requires EPA to provide adequate lead time “necessary to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance within such period,” section 209 also requires “appropriate consideration...to cost”.<sup>17</sup> As under section 202(a), the relevant costs under section 209 are compliance costs. There is no requirement that CARB prove a certain degree of cost-effectiveness nor meet a specified cost constraint as a condition of an authorization under section 209. Nevertheless, CARB is taking the opportunity to address concerns about the costs of the regulations and further demonstrate that CARB gave appropriate consideration to costs when exercising its judgment to adopt the regulations.

As described in CARB’s economic analysis in Chapters VII and VIII of the *ISOR* and in the *SRIA*, the metric used to quantify cost-effectiveness of the 2021 Amendments and alternatives was the ratio of total monetized benefits divided by total monetized costs. Of the alternatives considered by CARB, the 2021 Amendments had the highest benefit-cost ratio, 1.26:1, while being technologically feasible.

The acquisition costs for ZEE may often be higher at this time than for equipment in the small offroad category powered by combustion engines, but the overall projected costs for ZEE will often be lower because of the lower operational costs. Based on the prices and analyses used in the *SRIA* (Appendix I of the *ISOR*), professional users (non-landscaping businesses, landscapers, and government entities) were expected to experience cost-savings from purchasing ZEE in most SORE categories within five years. ZEE batteries can outlive the equipment. By keeping the batteries from the previous equipment, a second purchase of a piece of ZEE would cost about 30% less, according to Consumer Reports.<sup>18</sup> Furthermore, battery prices are dropping more rapidly than anticipated at the time of the rulemaking, leading to shorter expected payback periods in the future. And to further offset higher upfront costs at this time while technology develops further and market prices continue to drop, many incentive programs exist.

The *ISOR* identified some incentive programs, including the Carl Moyer Memorial Air Quality Standards Attainment Program (Carl Moyer Program), Community Air Protection Program, and local air district incentive programs. The California Legislature also approved an additional \$30 million to help small landscaping businesses purchase ZEE.<sup>19</sup> These funds

---

<sup>16</sup> *Id.* (quoting 46 Fed.Reg. 26,371, 26,372 (1981)).

<sup>17</sup> *Air Pollution Control; Preemption of State Regulation for Nonroad and Engine Vehicles*, 59 FR 36969, 36983 (July 20, 1994); 42 U.S.C. 7521(a), *cited by* 42 U.S.C. 7543(b)(1)(C).

<sup>18</sup> Consumer Reports, 5 Green Reasons to Choose Battery-Powered Lawn Tools, *supra*.

<sup>19</sup> California Air Resources Board. “*Public Hearing to Consider Proposed Amendments to the Small Off-Road Engine Regulations: Transition to Zero Emissions, Final Statement of Reasons for Rulemaking, Including Summary of Comments and Agency Response.*” 2022.

<https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2021/sore21/sorefsor.pdf>

created the well-received *California CORE Professional Landscape Service Equipment* (CORE LP) incentive program that was open through October 2023. CORE LP funded more than 27,000 pieces of equipment and 30,000 batteries from over 500 approved equipment models through 300 approved dealers. 63% of the funds went to microbusinesses, 21% to sole proprietors, and 16% to small businesses.<sup>20</sup> To address industry demand, \$24.7 million was allocated to fund zero-emission commercial lawn and garden equipment through the *Moyer State Reserve* with fiscal year 2021-2022 funds, in addition to the annual Carl Moyer Program funding. Some public entities provide additional cost savings for ZEE through incentives to customers.<sup>21,22</sup> Future legislation may provide for more tax credits. A bill to create a federal tax credit for the purchase of ZEE for small businesses, called the Promoting Reduction of Emissions Through Landscaping Equipment Act, includes a 40% credit on the purchase of zero-emission equipment and accessories up to \$25,000 per year and up to \$100,000 over the course of 10 consecutive years.

Aside from incentives, CARB's cost analysis showed landscapers using ZEE save costs within the first few years of purchase from decreased fuel, repair, and maintenance costs as compared to equipment with combustion engines, despite larger upfront costs. Businesses may decrease the impact of the significant one-time cost by gradually purchasing ZEE.

Prices of batteries are decreasing. Goldman Sachs forecasts battery prices will fall to \$99 per kilowatt hour (kWh) of storage capacity by 2025 – a 40% decrease from 2022 and 7% more than originally anticipated. Almost half of the decline will come from declining prices of electric vehicle (EV) raw materials, such as lithium, nickel, and cobalt, which are the same materials utilized in most ZEE batteries. Battery pack prices are now expected to fall by an average of 11% per year from 2023 to 2030.<sup>23</sup> ZEE batteries currently cost more per unit of energy than EV batteries, and this trend will likely continue. However, ZEE battery prices will likely decline due to decreasing raw mineral costs and increased economies of scale as production and demand increase. Pricing for ZEE batteries is correlated to pricing for EV batteries since they rely on the same market factors and raw materials. Further cost reductions are expected from an increased supply of batteries from new manufacturing. The International Energy Agency projects lithium-ion battery manufacturing will more than

---

<sup>20</sup> CALSTART. *"Professional Landscape Service Equipment Voucher Funds are Exhausted."* 2023. Accessed on March 27, 2024. <https://californiacore.org/2023/10/05/professional-landscape-service-equipment-voucher-funds-are-exhausted/>

<sup>21</sup> City of Glendale, California. *"Energy and Water Saving Rebate Program."* Accessed on March 27, 2024. <https://www.glendaleca.gov/government/departments/glendale-water-and-power/residential-customers/residential-programs/smart-home-rebate-program>

<sup>22</sup> City of San Mateo, California. *"Electric Leaf Blower Rebate."* 2023. Accessed on March 27, 2024. <https://www.cityofsanmateo.org/4544/Electric-Leaf-Blower-Rebate>

<sup>23</sup> Goldman Sachs. *"Electric vehicle battery prices are falling faster than expected."* 2023. Accessed on March 27, 2024. <https://www.goldmansachs.com/intelligence/pages/electric-vehicle-battery-prices-falling.html>



quadruple from 2022 to 2030 worldwide and undergo a more than nine-fold increase in the United States.<sup>24</sup>

The SORE regulations do not require owners and operators to immediately purchase new ZEE SORE equipment. The regulations allow existing CARB-certified SORE to continue to be sold, used, repaired, and maintained in 2024 and later by their owners for the remainder of their useful lives. The market will be enhanced by the availability of new ZEE SORE available for purchase while pre-2024 model year SORE sell out of existing inventory stocks. For commercial landscapers that do need new equipment but may not be in a position to purchase it, the regulated industry offers a monthly subscription for commercial landscapers to use ZEE without needing to pay for the high upfront costs.<sup>25</sup>

Recent ZEE market development combined with lower prices is resulting in owners realizing savings quicker than estimated in the *ISOR*. A recent Williams College study noted that a professional-grade electric riding mower will be 3.5 to 5 times less expensive to own and operate than a gasoline-fueled mower over a 10-year period.<sup>26</sup> Another independent analysis found the 10-year total cost of ownership of residential electric corded and cordless push mowers to be several hundred dollars less than for a gasoline mower. This again shows savings may occur more quickly than anticipated in the *ISOR*.<sup>27</sup> Several calculator tools have been developed by organizations and manufactures to guide consumers to estimate their return on investment for their specific use cases.<sup>28,29,30,31</sup>

A survey conducted by California State University, Fullerton (CSUF) on behalf of CARB (CSUF survey)<sup>32</sup> showed that residential users often keep their SORE for more than 10 years,

---

<sup>24</sup> International Energy Association. *"Lithium-ion battery manufacturing capacity, 2022-2030."* 2023. Accessed on March 27, 2024. <https://www.iea.org/data-and-statistics/charts/lithium-ion-battery-manufacturing-capacity-2022-2030>

<sup>25</sup> Landscape Management. *"Beyond the basics: Navigating the transition from gas to battery-powered equipment."* 2024. Accessed on March 27, 2024. <https://www.landscapemanagement.net/beyond-the-basics-navigating-the-transition-from-gas-to-battery-powered-equipment/>

<sup>26</sup> Williams College. *"Electric Lawn Mower Study Results."* 2023. Accessed on March 27, 2024. <https://sustainability.williams.edu/news-events/electric-lawn-mower-study-results/>

<sup>27</sup> Wise Bread Living Large On a Small Budget. *"We do the Math: Will an Electric Mower Trim Lawn Care Costs?"* 2024. Accessed on March 27, 2024. <https://www.wisebread.com/we-do-the-math-will-an-electric-mower-trim-lawn-care-costs>

<sup>28</sup> Consumer Reports. *"Is an Electric Lawn Mower Worth It?"* 2023. Accessed on March 27, 2024. <https://www.consumerreports.org/home-garden/lawn-mowers/can-a-battery-mower-save-money-over-a-gas-mower-a2312089191/>

<sup>29</sup> Mean Green Electric Mowers. *"The Electric Advantage."* Accessed on March 27, 2024. <https://meangreenproducts.com/the-electric-advantage/>

<sup>30</sup> Toro. *"The Future is Now."* Accessed on March 27, 2024. <https://revolution.toro.com/why-electric/>

<sup>31</sup> Stihl, How Your Business Can Save By Switching To Battery Power

<sup>32</sup> California State University, Fullerton Social Science Research Center. *"Survey of Small Off-Road Engines (SORE) Operating within California: Results from Surveys with Four Statewide Populations."* 2019. [https://ww2.arb.ca.gov/sites/default/files/2022-12/Survey%20Abstract%20and%20ES\\_ADA.pdf](https://ww2.arb.ca.gov/sites/default/files/2022-12/Survey%20Abstract%20and%20ES_ADA.pdf)

while commercial users average closer to 5 years. The longer term of ownership in residential use provides greater cost savings.

The CSUF survey found that non-landscaping businesses may not achieve cost-savings within 5 years when owning either corded or cordless ZEE pressure washers due to reported average usage of only once per week, with minimal opportunities for operational cost savings, suggesting renting from equipment rental services, such as Sunbelt Rentals, might be more economically favorable. Similarly, the break even point for professional ZEE riding mowers is estimated to be longer than the 5-year median age in the CSUF survey. However, the current trend shows more manufacturers entering the market due to the 2021 Amendments. The greater supply is expected to result in reduced cost. An additional benefit of ZEE is the quieter operation, which allows greater flexibility in using the equipment throughout the workday, without noise restriction concerns. Greater supply, lower battery cost, and freedom of use will further drive down the overall cost of ZEE.

## **IV. The Diversity and Flexibility of the Latest Zero-Emission Technologies**

There are a variety of zero-emission power sources available for many kinds of equipment and needs. ZEE has been available for many equipment types, such as cordless drills and trimmers, for decades. These battery-operated tools contain batteries that may be used to power other electric and cordless equipment. The level of performance, number of brands, and number of equipment options have increased greatly and continue to do so.

An example of a general-purpose zero-emission power unit is Honda's eGX. The Honda eGX uses a lithium-ion battery-powered electric motor with a similar shape and same output shaft position as Honda's GX series internal combustion engines that are used in construction machinery. This allows users to easily swap engines with zero-emission power units while maintaining the same performance characteristics and durability as the GX series combustion engines.<sup>33</sup> The interchangeability of batteries also minimizes the number of batteries needed.

For generator applications for serving greater demands in either capacity or duration, Oncore Energy hydrogen fuel cell generators can be fueled with exchangeable hydrogen cylinders. They can also be coupled with an electrolyzer to convert solar (or wind) energy to hydrogen and provide commercial energy solutions for homeowners, businesses, and construction sites. Power sizing is scalable to fit various needs whether one is looking to power a home or an entire agricultural grid. Commercial fuel cell generators may provide 100 kW or more.<sup>34</sup> The average United States household consumes about 10,500 kWh of

---

<sup>33</sup> Honda. *"The Next Generation eGX Experience."* Accessed on March 27, 2024.  
<https://engines.honda.com/egx>

<sup>34</sup> Oncore Energy. *"Commercial use of Hydrogen Fuel Cell Generator."* Accessed on March 27, 2024.  
<https://oncoreenergy.com/applications/commercial/>

electricity per year or 29 kWh per day.<sup>35</sup> The amount of backup power needed will vary for each household. Some households will need power for essentials, such as a refrigerator that may use 1-4 kWh per day. Other households may choose to have complete backup power for all their electrical appliances and devices. The Oncore Energy units are scalable (e.g., 4 kW, 8 kW, 12 kW, 16 kW, 20 kW) to allow sizing to fit each household's needs.<sup>36</sup> Oncore Energy also provides options with 1 megawatt (MW) or more for heavy industrial users.<sup>37</sup> This equipment may be installed in a mobile trailer, which is transportable to power ZEE during the day at job sites.

Firman has introduced portable power stations under the Zero E brand with continuous power of 2,000 watt (W) and peak power of 4,000 W. This modular system is expandable to up to 10 portable power packs. The Zero E is expected to retain 80% or more of its original energy capacity after 4,000 charge cycles.<sup>38</sup>

Stihl offers batteries, such as the AP 500 S, that meet professional user needs. The power laminate cell technology provides up to a 2,500-cycle life. The AP 500 S has 337 Wh capacity and weighs 4.2 lbs<sup>39</sup> Husqvarna offers several batteries for commercial use. The Bli300 series battery, 337 Wh capacity, weighs less than 5 pounds and is intended to be a more portable solution than backpack batteries. The Bli950X is a backpack battery with more than 1 kWh in capacity.<sup>40</sup> Several manufacturers have published battery runtime charts to help users select the appropriate battery to meet their needs.<sup>41,42</sup>

Advancements in other sectors, such as construction work, are developing as well. The DEWALT POWERSHIFT™ optimizes concrete job sites through electrification. It features six concrete tools that are powered by a 554 Wh battery. The line includes a 550 W charger and a FLEXVOLT® to POWERSHIFT™ adapter for additional runtime.<sup>43</sup> In a recent survey by DEWALT, 91% of construction professionals surveyed believe their construction sites are adequately fitted for using fully electric-powered tools and 83% of respondents reported

---

<sup>35</sup> U.S. Energy Information Administration. "Use of Energy Explained, Energy Use in Homes." 2023. Accessed on March 27, 2024. <https://www.eia.gov/energyexplained/use-of-energy/electricity-use-in-homes.php>

<sup>36</sup> Oncore Energy. "Oncore Energy Hydrogen Fuel Cell Generator Features." Accessed on March 27, 2024. <https://oncoreenergy.com/features/>

<sup>37</sup> Oncore Energy. "Heavy Industrial Hydrogen Fuel Cell Generator." Accessed on March 27, 2024. <https://oncoreenergy.com/applications/heavy-industrial/>

<sup>38</sup> Firman Power Equipment. "Zero E Portable Expandable Power Station." Accessed on March 27, 2024. <https://firmanpowerequipment.com/collections/zero-e/products/e201001>

<sup>39</sup> Stihl. "AP 500 S." 2024. <https://www.stihlusa.com/products/batteries-and-chargers/batteries/ap500s>

<sup>40</sup> Husqvarna. "Charge a new path in commercial landscaping - Introducing the 525i series." Accessed on March 27, 2024. <https://www.husqvarna.com/us/discover/commercial-battery-products/>

<sup>41</sup> Stihl. "AP System Battery Chart." Accessed on March 27, 2024. <https://www.stihlusa.com/guides-projects/a/ap-system-battery-chart/>

<sup>42</sup> Husqvarna. "Battery Runtime Chart." Accessed on March 27, 2024. <https://www.husqvarna.com/us/discover/battery-runtime-chart/>

<sup>43</sup> DEWALT. "DEWALT POWERSHIFT™: The Shift is Here." Accessed on March 27, 2024. <https://www.dewalt.com/systems/powershift>

that battery-powered tools allowed them to complete projects up to two to three times faster than gas-powered tools.<sup>44</sup> Vanguard also introduced its 48 V, 1.5 kWh commercial swappable batteries that have parallel capability to deliver more power. They are advertised as reliable and durable, designed to withstand abuse, debris, water, and dirt. With an 8-year commercial limited warranty, they are designed for up to 1,000 cycles to 80% initial capacity.<sup>45</sup>

Some landscapers have expressed concerns regarding electrical service upgrades. The 2021 Amendments do not require anyone to make upgrades in electrical service, and much of the ZEE is charged through 15- and 20-amp circuits that are readily available, although some users may choose to do so. Smart charging switches allow for the charging of many batteries on just one electrical circuit without exceeding the current rating of the circuit. The PGX™ Commercial Charging 1600 W Hub charges up to 70 batteries overnight from any standard 15 amp, 120 volt (V) outlet.<sup>46</sup> The PGX™ Commercial Charging 3-Port Dock charges three batteries simultaneously, and up to 24 docks connect to a single PGX™ Commercial Charging 1600 W Hub.<sup>47</sup> Stihl offers a multi-charger that can sequentially charge up to four AP 300 S batteries in just under five hours.<sup>48</sup> Battery charging trailers and battery electric vans outfitted with on-board energy storage and rooftop solar panels increase operational flexibility by allowing charging from any location through the workday.<sup>49,50</sup>

---

<sup>44</sup> Wood, Gigi. "DEWALT Survey Shows Las Vegas Contractors Confident in Electric Tools." 2024. Accessed on March 27, 2024. <https://www.forconstructionpros.com/equipment/fleet-maintenance/batteries/article/22884769/dewalt-dewalt-survey-shows-las-vegas-contractors-confident-in-electric-tools>

<sup>45</sup> Vanguard. "48V 1.5kWh Commercial Battery: Swappable Battery Pack - Si1.5." Accessed on March 27, 2024. [https://www.vanguardpower.com/na/en\\_us/product-catalog/lithium-ion-battery/1\\_5kwh-swappable-battery-pack.html](https://www.vanguardpower.com/na/en_us/product-catalog/lithium-ion-battery/1_5kwh-swappable-battery-pack.html)

<sup>46</sup> EGO. "PGX™ Commercial Charging 1600W Hub." Accessed on March 27, 2024. <https://egopowerplus.com/pgx-commercial-charging-1600w-hub-pgx1600h/>

<sup>47</sup> EGO. "PGX™ Commercial Charging 3-Port Dock." Accessed on March 27, 2024. <https://egopowerplus.com/pgx-commercial-charging-3-port-dock-pgx3000d/>

<sup>48</sup> Stihl. "AL 301 4 Multi Charger." Accessed on March 27, 2024. <https://www.stihlusa.com/products/batteries-and-chargers/chargers/al3014multicharger/>

<sup>49</sup> Greenworks Commercial. "OptimusMC Mobile Charging Trailer." Accessed on March 27, 2024. <https://www.greenworkscommercial.com/pages/trailer>

<sup>50</sup> Green Car Reports. "2024 Ford E-Transit electric vans get bigger battery, more range." 2024. Accessed on March 27, 2024. [https://www.greencarreports.com/news/1142483\\_2024-ford-e-transit-electric-vans-get-bigger-battery-more-range?utm\\_source=GCR+-+Daily+Headlines&utm\\_campaign=571c071e27-EMAIL\\_CAMPAIGN\\_2024\\_03\\_05\\_05\\_05&utm\\_medium=email&utm\\_term=0\\_7e18d5fd93-571c071e27-%5BLIST\\_EMAIL\\_ID%5D](https://www.greencarreports.com/news/1142483_2024-ford-e-transit-electric-vans-get-bigger-battery-more-range?utm_source=GCR+-+Daily+Headlines&utm_campaign=571c071e27-EMAIL_CAMPAIGN_2024_03_05_05_05&utm_medium=email&utm_term=0_7e18d5fd93-571c071e27-%5BLIST_EMAIL_ID%5D)

## V. Model Year 2024 Certifications

Exhibit C provides details of the engine and evaporative families that have been certified for use in pressure washers and portable generators that meet the more stringent model year 2024 emission standards. In total, as of March 12, 2024, there are 48 engine and evaporative families certified between Class I and Class II for MY 2024 SORE. The 2021 Amendments include the zero-emission generator credit program which allows manufacturers to earn emission reduction credits for zero-emission generators. More emission reduction credits are granted for zero-emission generators with greater energy storage and power delivery than for those with less energy storage and power delivery. Zero-emission generator credits may only be used to offset generator engine emissions.

## VI. Safety

CARB is monitoring safety of the equipment through our implementation efforts that include hosting quarterly landscaper workgroup meetings, responding to inquiries received online and in our [SORE@arb.ca.gov](mailto:SORE@arb.ca.gov) inbox, and engaging directly at landscaping trade shows and through the [ZEE Roadshow](#). CARB staff will report to its Board in annual implementation reports and a technology review in 2026.

Safety is often a more significant concern for gasoline powered equipment than for ZEE. CAL Fire requires all portable gasoline-powered equipment, which includes lawnmowers, to have spark arrestors when used in wildland areas.<sup>51</sup> Spark arrestors trap or destroy hot exhaust particles from internal combustion engines for fire prevention.<sup>52</sup> The exhaust system, spark arrestors, and equipment must be in proper working order and free of carbon buildup to minimize fire risk. Gasoline-powered lawn mowers can also start fires when grass gets caught in the muffler or engine, when a user checks the fuel improperly, or when a leaky gasket in the carburetor causes fuel to leak.<sup>53</sup> Gas tanks must be filled when the engine is turned off and cool since running engines can spark and ignite gasoline.<sup>54</sup> Users must also move at least 10 feet from the fueling spot before starting a lawn mower to avoid

---

<sup>51</sup> Cal Fire. "One Less Spark." Accessed on March 27, 2024. <https://www.readyforwildfire.org/prevent-wildfire/equipment-use/>

<sup>52</sup> United States Department of Agricultural Forest Service Technology & Development Program. "Fire Management Tech Tips." 2003. Accessed on March 27, 2024. <https://www.fs.usda.gov/t-d/pubs/html/03511304/03511304.htm#:~:text=A%20spark%20arrester%20is%20a,on%20certain%20types%20of%20engines>

<sup>53</sup> Oregon AAA. "Tips to Prevent Lawnmowers Fires." Accessed on March 27, 2024. <https://info.oregon.aaa.com/tips-to-prevent-lawnmower-fires/#:~:text=Before%20mowing%20the%20grass%2C%20refill,set%20the%20lawnmower%20on%20fire.&text=A%20lawnmower%20can%20overheat%20or,carburetor%20has%20a%20leaky%20gasket>

<sup>54</sup> Chatham County, North Carolina. "Gasoline is Made to EXPLODE!" Accessed on March 27, 2024. <https://www.chathamcountync.gov/government/departments-programs-a-h/fire-marshal/fire-safety/gasoline-safety>

ignition of gasoline vapors that can travel along the ground.<sup>55</sup> The United States Consumer Product Safety Commission has issued numerous recalls for lawn mowers that posed fire hazards caused by leaking fuel.<sup>56</sup>

While CARB is technology neutral with respect to the power unit for ZEE, CARB understands the most well-publicized safety concern with batteries is thermal runaway, a failure mode in which a battery is heated beyond its range of thermal stability, after which the battery's internal heat makes the runaway self-sustaining.<sup>57</sup> This can occur with any battery—there have been a number of well-publicized incidents in the past where failing batteries started fires or exploded.<sup>58</sup> Industry has since reduced this concern with battery pack design features such as short-circuit shutoffs and short-resistant terminals as well as an industry shift to more stable cathode chemistries, particularly lithium iron phosphate (LFP) cathodes. LFP cells are less likely to experience thermal runaway, which reduces the chances of heat from one shorted cell causing a chain reaction throughout the battery pack or of cell components becoming hot enough to ignite vented electrolyte before the reaction is disrupted.

Manufacturers of batteries and landscaping equipment are evolving, as are fire safety requirements from organizations and agencies with the mandates and expertise to address such risks. CARB's regulations, therefore, are limited to ensuring air pollution from SORE are reduced and eliminated and do not cause additional risks. Nevertheless, CARB is tracking fire safety and recalls for SORE, and separately welcomes federal action on battery fire safety.

Although thermal and UV exposure are built into the SORE test procedures, the ability of SORE and ZEE to withstand exposure to the elements is largely beyond the scope of emission regulations, and it is assessed in other safety standards. For example, lawn mower safety standards are specified in ANSI/OPEI B71.1-2017 (Pedestrian-Controlled Mowers And Ride-On Mowers - Safety Specifications). Federal rules prohibit emission control systems or features in emissions control systems that compromise the safety of the user.<sup>59</sup> Manufacturers have ensured some ZEE are rated with water-resistant capabilities as well.

---

<sup>55</sup> City Of Phoenix. *"Fire Outdoor Safety."* Accessed on March 27, 2024. <https://www.phoenix.gov/fire/safety-information/outdoor>

<sup>56</sup> United States Consumer Product Safety Commission. *"Search: lawn mower leak."* Accessed on March 27, 2024. [https://www.cpsc.gov/search?search\\_api\\_fulltext=lawn+mower+leak&created=&created\\_1=&sort\\_bef\\_combine=search\\_date\\_DESC](https://www.cpsc.gov/search?search_api_fulltext=lawn+mower+leak&created=&created_1=&sort_bef_combine=search_date_DESC)

<sup>57</sup> Battery Power Online. *"Thermal Runaway: Understanding the Fundamentals to Ensure Safer Batteries"* 2019. Accessed on March 27, 2024. <https://www.batterypoweronline.com/news/thermal-runaway-understanding-the-fundamentals-to-ensure-safer-batteries/>

<sup>58</sup> Mikolajczak, et al., via The Fire Protection Research Foundation. *"Lithium-Ion Batteries Hazard and Use Assessment - Final Report."* 2011. <https://www.nrc.gov/docs/ML1719/ML17191A294.pdf>

<sup>59</sup> 40 C.F.R. 1060.101(e)(2).

Many models of ZEE, such as the EGO *Power+ 21" self-propelled mower* and Husqvarna 525iLST string trimmer are IPX4-rated weather-resistant.<sup>60,61</sup>

## VII. Regulatory Requirements for ZEE Batteries

Batteries must meet all CARB requirements to be utilized in ZEE-certified to earn emission reduction credits.<sup>62</sup> This means they must meet warranty and durability requirements relating to test power load, battery capacity, and other performance requirements, and that maintenance and use instructions must be provided by the manufacturer as well.<sup>63</sup>

Manufacturers are required to work with the battery manufacturer to ensure the battery can meet the warranty requirements.<sup>64</sup> Title 13, California Code of Regulations (CCR), section 2408.1 and 13 CCR 2408.2 list the power and performance specifications for the batteries in various ZEE. The SORE regulations entice ZEE manufacturers to provide higher quality batteries by awarding more credits to batteries with higher power and increased energy storage.<sup>65</sup> CARB focuses on maintaining a balance in encouraging market development while continuing to provide consumer protection.

## VIII. Battery Life

SORE regulations require that manufacturers earning ZEE credits warrant equipment, including the battery and battery chargers, to be free from defects for a minimum of 2 years. Similarly, SORE manufacturers must warrant emissions-related parts to be free from defects for a minimum of 2 years.<sup>66</sup> The SORE regulations, in title 13 of the CCR, section 2405(e), require manufacturers furnish written instructions for the maintenance and use of the engine. 13 CCR section 2406 requires the manufacturer to furnish a written warranty statement for the emission control system that includes owner's responsibilities as well as manufacturer contact information.

Degradation from weather exposure is not necessarily a limitation of zero-emission technology. Batteries in ZEE, unlike batteries in vehicles, often have the advantage of being sheltered and protected from the elements when not in operation. Some batteries, such as those from EGO, are equipped with an advanced self-maintenance function so that the battery maintains 30% charge automatically after it is stored over one month. The SORE

---

<sup>60</sup> EGO. "*Power+ 21" Self-Propelled Mower.*" Accessed on March 27, 2024. <https://egopowerplus.com/21-inch-self-propelled-mower/>

<sup>61</sup> Husqvarna. "*525iLST Battery String Trimmer.*" Accessed on March 27, 2024. <https://www.husqvarna.com/us/string-trimmers/525ilst-tool-only/>

<sup>62</sup> Cal. Code Regs., tit. 13, sec. 2405(h)(2).

<sup>63</sup> Cal. Code Regs., tit. 13, sec. 2405(h), 2408.1, and 2408.2.

<sup>64</sup> Cal. Code Regs., tit. 13, sec. 2405(h).

<sup>65</sup> Cal. Code Regs., tit. 13, sec. 2408.1(b), 2408.2(b), and 2754.3(b).

<sup>66</sup> Cal. Code Regs., tit. 13, sec. 2405(b) and 2760(b).

regulations require manufacturers to provide maintenance and use instructions that help prolong the useful life of the equipment. While SORE regulations do not require users to responsibly care for their engines or equipment, they do caution users that warranty coverage may be denied if a part fails due to user abuse, neglect, improper maintenance, or unapproved modifications.<sup>67</sup>

In response, some manufacturers, such as Husqvarna, provide battery runtime charts for various equipment types and tasks, such as chainsaws and pole saws for forestry, pruning, and log cutting. This helps operators know how much power they will have and how many batteries are required for various jobs.<sup>68</sup> To assist with battery storage and transportation, Husqvarna offers the Transportation Box which includes inserts that provide thermal insulation to protect the batteries from extreme heat or cold.<sup>69</sup> Similarly, the Greenworks Commercial 82 V battery is lightweight, features optimized venting for cooling, and fits more than 50 different products. It includes a 2-year battery limited warranty and has Bluetooth capability to easily register and track battery performance using the Greenworks Commercial app.<sup>70</sup>

When batteries reach the end of their useful life, existing laws and regulations governing solid waste, such as California's Universal Waste Rule, require batteries to be recycled, refurbished or reused to avoid chemical release to the environment.<sup>71</sup> To meet the increased resulting demand for recycled batteries, manufacturers, such as Stihl and Husqvarna, work with Call2Recycle where landscape professionals can drop off batteries at the end of their service life. EGO partners with Rechargeable Battery Recycling Corporation to help landscapers locate drop boxes to recycle batteries.<sup>72</sup>

---

<sup>67</sup> Cal. Code Regs., tit. 13, sec. 2406(a) and 2764(b).

<sup>68</sup> Husqvarna battery runtime chart, *supra*.

<sup>69</sup> Husqvarna. "Husqvarna Battery Transportation Box - UN3480." Accessed on March 27, 2024. <https://www.husqvarna.com/us/battery-series-accessories/battery-transportation-box-un3480/>

<sup>70</sup> Greenworks Commercial. "82V 2.5Ah Battery with Bluetooth and Digital Readout (82BD250)." Accessed on March 27, 2024. <https://www.greenworkscommercial.com/products/82v-2-5-ah-battery-w-bluetooth-and-digital-readout-new-for-2022-replaces-gl250>

<sup>71</sup> Cal. Code Regs., tit. 22, Chapter 23, sec. 66273.1 - 66273.89.

<sup>72</sup> The Edge. "The Shift from Gas to Battery." 2023. Accessed on March 27, 2024. <https://blog.landscapeprofessionals.org/the-shift-from-gas-to-battery/>



## IX. Battery Durability

When a manufacturer certifies SORE for sale, lease, use, or operation in California, it is required to choose an emissions durability period, representing an engine's useful life.<sup>73</sup> Currently, emissions durability periods for SORE in California range from 50 to 1000 hours due to the many points of failure in the moving parts inside an internal combustion engine.

ZEE, in contrast, often utilizes electric motors. These electric motors are often either brushed or brushless direct current motors, with the brushless motors being the newest and most preferred option. Electric motors have far fewer moving parts than engines. Recent studies verify this leads to significantly longer lifespans of the motors, with brushed electric motors operating between 1,000 and 3,000 hours, depending on the material composition of the brushes.<sup>74,75</sup> Based on market reports, staff expect the majority of new ZEE will be battery powered-, as two of three homeowners prefer ZEE over gasoline-powered equipment.<sup>76</sup> The majority of battery-powered equipment utilizes brushless motors due to the increased efficiency and lifespan of the motors. Brushless motors can operate for tens of thousands of hours, depending on the quality of the bearings that are used in the motor.<sup>77,78</sup> Overall, electric motors provide a service life that is significantly longer than internal combustion engines. CARB will continue to monitor the useful life of ZEE, including through another survey of SORE population and use with CSUF.

ZEE often has a longer limited warranty period than SORE equipment. For instance, Stihl offers limited warranties of three years for residential use and two years for professional use on all their battery equipment as opposed to one to two years for residential and three months to two years for the gasoline-powered equipment.<sup>79</sup> The comparatively limited warranty periods for SORE suggest manufacturers recognize that ZEE generally have a longer lifetime than SORE equipment. The longer lifespan of ZEE helps users save money by extending the period before they purchase replacement equipment and avoiding engine maintenance, such as oil and spark plug changes.

Battery degradation is based in part on the number of charging and discharging cycles. However, the ZEE credit program requires batteries to meet durability requirements that are

---

<sup>73</sup> 13 CCR sec. 2403(e).

<sup>74</sup> Perzan, Angelica. "Brushed vs. brushless DC motors." 2021. Accessed on March 27, 2024.  
<https://drive.tech/en/stream-content/brushed-vs-brushless-dc-motors>

<sup>75</sup> Janjua, Amir. "Choosing a Brushed or Brushless DC Motor." 2017. Accessed on March 27, 2024.  
<https://www.engineeringspecifier.com/drives-motors/choosing-a-brushed-or-brushless-dc-motor>

<sup>76</sup> The Farnsworth Group. "9 Findings from the 2022 Gas vs Battery OPE Usage and Perception Report." Accessed on April 3, 2024. <https://www.thefarnsworthgroup.com/blog/findings-from-gas-vs-battery-ope-report>

<sup>77</sup> Brushed vs. brushless DC motors, *supra*

<sup>78</sup> Choosing a Brushed or Brushless DC Moto, *suprar*

<sup>79</sup> STIHL USA. "STIHL Products Limited Warranty Information." Accessed on March 27, 2024.  
<https://www.stihlusa.com/information/warranty-service-info/limited-warranty/>

equivalent to the number of hours that engines are required to meet the applicable emission standards.<sup>80</sup> 13 CCR section 2408.1(b)(4)(B) requires 300 hours for ZEE with performance equivalence to engines with displacement less than or equal to 80 cc; 500 hours for ZEE with performance equivalence to engines with displacement between 80 cc and 225 cc.<sup>81</sup> These durability requirements are already part of the California program authorized by the EPA.

Like other SORE, proper maintenance is necessary to maximize the life of ZEE. ZEE manufacturer recommendations for maintenance vary. Examples include leaving equipment connected to a charger when it is not in use, charging the batteries at least once a month during storage, and removing battery packs and storing them separately in a dry location and at room temperature.<sup>82</sup> End users buying equipment may select the appropriate battery size that suits their needs.

## **X. CARB's Limited-Term EO Program Does Not Retroactively Enforce the SORE Regulations nor does it Reduce Lead Time to Comply**

Comment letters submitted to EPA in March 2024 described concerns that "CARB has even reserved the right to enforce the amended SORE standards retroactively..."<sup>83</sup> and that the issuance of limited-term EOs "fails to provide regulated entities with *any* lead-time from when the Amendments are finalized through a valid waiver and reflects retroactive enforcement of the rule to a period before [CARB] held a valid waiver of preemption."<sup>84</sup> Neither of these statements reflects the accurate state of certification for the SORE program as it is presently being administered.

Adopted on December 9, 2021<sup>85</sup>, and approved for publication by the Office of Administrative Law on September 14, 2022, CARB's more stringent emission standards from the 2021 Amendments to the SORE regulations did not take effect until model year 2024. There is nothing "retroactive" about these requirements or CARB's rulemaking. However,

---

<sup>80</sup> Cal. Code Regs., tit. 13, sec. 2408.1(b)(4)(B) and 2408.2(b)(4)(B).

<sup>81</sup> Cal. Code Regs., tit. 13, sec. 2408.1(b)(4)(B).

<sup>82</sup> Ryobi. "Operator's Manual, Electric Zero Turn Mower, RY48140/RY48141." 2024.

[https://556aa8d9de68ea9c4f29-0a8acad11a4df5016d26cc39a7429843.ssl.cf1.rackcdn.com/2/RY48140\\_099749046\\_402\\_OM\\_trilingual\\_03.pdf](https://556aa8d9de68ea9c4f29-0a8acad11a4df5016d26cc39a7429843.ssl.cf1.rackcdn.com/2/RY48140_099749046_402_OM_trilingual_03.pdf)

<sup>83</sup> Truck & Engine Manufacturers Association (EMA) Letter, Mar. 13, 2024.

<sup>84</sup> Outdoor Power Equipment Institute (OPEI) Letter, Mar. 8, 2024.

<sup>85</sup> *Window Covering Manufacturers Ass'n v. Consumer Product Safety Commission*, 82 F.4th 1273, 1292 (D.C. Cir. 2023) [Court ruled manufacturers' compliance obligations began when the Final Rule was promulgated. CARB's final rule was promulgated December 9, 2021, and approved for publication by the Office of Administrative Law on September 14, 2022. The comment letters mistakenly cite August 1, 2022, which is the date the rule went to OAL, as the operative date.]

because EPA has not yet taken final action on CARB's request for authorization for the 2021 Amendments to the SORE regulation, CARB developed two paths for manufacturers certifying new MY 2024 SORE to pursue: (1) certifying engines and equipment to the emission standards for SORE with a standard EO, as adopted by the CARB Board on December 9, 2021, that will remain valid for the remainder of the SORE's useful life or (2) certifying engines and equipment to the MY 2023 standards with a limited-term EO. The limited-term EO terminates once EPA grants authorization and that authorization is published in the Federal Register. SORE offered for sale under a limited-term EO would not be eligible for sale in California on or after the date of EPA's published authorization. But any SORE sold under a limited-term EO while that EO was valid will not incur an enforcement action. Nothing CARB has planned or announced involves retroactive enforcement. Indeed, no manufacturer can claim surprise at the standards it must meet. CARB promulgated these standards in 2021 with the effective date that still stands. It provided manufacturers with the *option* to request limited term EOs to allow increased time for compliance in light of the ongoing authorization proceeding. But that does not make post-authorization revocation of any such EO "retroactive."

To the extent certain commenters' concerns lie with the timing of EPA authorization, that adjudicatory proceeding does not establish the standards and other requirements with which manufacturers must comply. Rather, like judicial adjudications reviewing agency rules, authorization proceedings determine whether or not the already-established rules are enforceable. Unlike rulemakings, such adjudications often have "retroactive" effect.<sup>86</sup> Commenters' concerns are, thus, better directed at Congress, which established the authorization adjudications, than at CARB's regulation or EPA's authorization proceeding. Indeed, commenters seek to have the statute function contrary to Congress's intent. They would have EPA's authorization proceeding determine the effective date of state law. Setting aside the obvious federalism concerns with that notion, Congress made the opposite choice: "to permit California to blaze its own trail with a minimum of federal oversight."<sup>87</sup>

Communications with manufacturers indicate that, while several manufacturers have obtained limited-term EOs from CARB, they do not appear to be offering the equipment for sale in California to a significant extent. Manufacturers have had since December 9, 2021, to begin preparing for the MY 2024 standards. While the comment letters argue their lead time should not start until EPA publishes the authorization for CARB's 2021 Amendments to the SORE regulations, this is a distortion of the law. Manufacturers are on notice as to their obligations when the final rule is promulgated.<sup>88</sup> Indeed, here, it is clear manufacturers are aware of their requirements and have begun preparing for their compliance obligations.

---

<sup>86</sup> *E.g., Ray v. Cnty. of Los Angeles*, 935 F.3d 703, 714-15 (9th Cir. 2019).

<sup>87</sup> *Am. Trucking Ass'ns, Inc. v. EPA*, 600 F.3d 624, 629 (D.C. Cir. 2010).

<sup>88</sup> *Id.* See also 88 Fed. Reg. 20711, fn. 208 (April 6, 2023) "EPA evaluates the lead time associated with CARB's regulation by examining the date of CARB's adoption of the regulation and when manufacturers are required to meet the regulation."

Manufacturers are already taking advantage of CARB's emissions reduction credit program to further aid in their future compliance. As indicated in Exhibit C, manufacturers are meeting the more stringent 2021 Amendments to the SORE regulation standards already, even in pressure washers and generators. As discussed above, the technology and availability are developing faster than CARB initially anticipated, so given the two years already built in before the MY 2024 standards took effect, the availability of the optional limited-term EO program, variable options manufacturers have to comply, and that manufacturers are already meeting the more stringent standards, CARB does not foresee a concern with the lead time for industry to come into compliance.

## **XI. There is No Basis for Piecemeal Authorization of CARB's SORE Regulations**

Some commenters have expressed opinions that CARB's regulations should be authorized for only certain classifications, such as engines used in residential equipment, or only for certain equipment types. There are no grounds for the EPA to entertain such a suggestion. Delaying implementation of new requirements for SORE used in professional equipment would cause an impediment to progress toward attaining the National Ambient Air Quality Standards and statewide commitments. Professionals typically have shorter equipment life cycles and higher use times than residential SORE equipment users. On average, landscapers use a lawn mower 240 hours per year, while residential users use a lawn mower 19 hours per year.<sup>89</sup> Emissions from landscapers' equipment are 21% of the overall emissions from SORE.<sup>90</sup> The noncompliance rate with current evaporative emission standards is high (~40% since 2015<sup>91</sup>, see *ISOR* section II.A.1), so previously expected emission reductions will not be realized without ZEE requirements for commercial equipment. More importantly, for the reasons discussed above, the SORE regulations meet the criteria for authorization in every category. There is no basis for denying authorization for commercial equipment.

## **XII. Conclusion**

CARB's supplemental information supports the technical and economic feasibility of the amendments. The retroactive enforcement concerns expressed recently by OPEI and EMA lack merit. The request for authorization pursuant to Clean Air Act section 209(e)(2) should be approved swiftly so that CARB can implement and enforce the emission reductions necessary to protect public health, particularly for those that endure some of the nation's

---

<sup>89</sup> 2020 SORE Emissions Model

<sup>90</sup> *Id.*

<sup>91</sup> California Air Resources Board. *"Public Hearing to Consider Proposed Amendments to the Small Off-Road Engine Regulations: Transition to Zero Emissions, Staff Report: Initial Statement of Reasons."* 2021. <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2021/sore21/isor.pdf>

David Dickinson  
May 8, 2024  
Page 21

worst air pollution. If you require any additional information, please do not hesitate to contact the handling attorneys for this matter: Linda Echegaray, [Linda.Echegaray@arb.ca.gov](mailto:Linda.Echegaray@arb.ca.gov), (279) 208-7307 or alternatively, Pippin Brehler, [Pippin.Brehler@arb.ca.gov](mailto:Pippin.Brehler@arb.ca.gov), (279) 208-7445.

Sincerely,



Steven S. Cliff, Ph.D., Executive Officer, California Air Resources Board

Enclosures: Exhibit A - Additional Examples of Residential and Professional Zero-Emission Equipment Available as of April 2024  
Exhibit B - CARB Responses to EPA Hearing Comments, Technological and Economic Feasibility  
Exhibit C - Engine and Evaporative Families Certified to Model Year 2024 Emission Standards as of March 2024  
Master Reference List

cc: Edie Chang, Deputy Executive Officer, California Air Resources Board

**Exhibit A - Additional Examples of Residential and Professional Zero-Emission Equipment Available as of April 2024**

This workbook, Exhibit A, contains information on residential and professional zero-emission landscaping equipment advertised online at the beginning of 2024. It builds on the equipment types, performance characteristics, and costs provided in the Initial Statement of Reasons, which make up more than 90% of the market.

The tab labeled "Residential" contains information on equipment geared for residential users, and the tab labeled "Professional" contains information on equipment geared for professional users. The distinction between residential and professional equipment is determined through marketing. Many manufacturers advertise certain equipment as intended for commercial use and offer commercial warranties.

CARB contracted with the Social Science Research Center at California State University, Fullerton (CSUF) to conduct an intensive survey between 2017 and 2019 of households, nonlandscaping businesses, and landscapers on their ownership and use of small off-road equipment, and other related topics (CSUF survey) which was used in analysis for the ISOR during the development of the 2021 Amendments. For professional use in this workbook, staff estimate the number of batteries needed for a typical workday using the CSUF survey.

Exhibit A – Additional Examples of Residential  
and Professional Zero-Emission Equipment  
Available as of April 2024

Units of Measure	
Ah	ampere hour
cc	cubic centimeter
ft	feet
gpm	gallons per minute
hp	horsepower
hr	hour
kW	kilowatt
kWh	kilowatt hour
lbs	pounds
mph	miles per hour
N	newton
Nm	newton meter
psi	pounds per square inch
sq. ft.	square feet
V	volts
W	watt
Wh	watt hour

## Exhibit A - Additional Examples of Residential ZEE Available as of April 2024

Equipment type	Make and model	Power*	Battery capacity	Typical battery runtime	Battery warranty period	Number of batteries used in equipment
Brush Cutter	<a href="#">Echo eFORCE 56V X Series DSRM-2600UR2</a>	"equal to a 25 cc gas-powered brushcutter"	<a href="#">252 Wh</a>	Up to 54 minutes	<a href="#">2 years</a>	1
Chainsaw	<a href="#">Ryobi RY405110</a>	"More power than a 50 cc gas chainsaw"	40 V, 8 Ah	Up to 100 cuts/charge	3 years	1
Chainsaw	<a href="#">Stihl MSA 60C-B</a>	"ideal for general yard maintenance and firewood cutting"	<a href="#">36 V, 4 Ah</a>	Up to 40 minutes	<a href="#">3 years</a>	1
Edger	<a href="#">Dewalt 20V MAX DCED400M1WZO400</a>	Up to 2 inch cutting depth	20 V, 4 Ah	60 minutes	3 years	1
Generator Set	<a href="#">Firman ZERO-E E201001</a>	2,000 W (4,000 W peak)	1.04-11.4 kWh	NA; Depends on load	<a href="#">3 years</a>	1 (integrated) + up to 10 power packs
Generator Set	<a href="#">Westinghouse iGen1000s</a>	1,500 W (3,000 W peak)	1,008 Wh	NA; Depends on load	2 years	1 (integrated)
Generator Set	<a href="#">Anker 535 PowerHouse</a>	500 W	512 Wh	NA; Depends on load	5 years	1 (integrated)
Lawn tractor	<a href="#">Troy-Bilt Super Bronco 42E XP 33ABA7KS766</a>	Up to 5.5 mph forward/ 3 mph reverse speed	3,000 Wh	Up to 3.5 acres/charge or 1.5 hours	3 years	1
Lawn tractor	<a href="#">Cub Cadet XT1 LT42E 33ABA7ES710</a>	Up to 5.5 mph forward/ 3 mph reverse speed	3,000 Wh	Up to 3.5 acres/charge or 1.5 hours	4 years	1

NA = not applicable

\*Rated power or manufacturer performance description

\*\*Information not published online or provided upon request



## Exhibit A - Additional Examples of Residential ZEE Available as of April 2024

Equipment type	Make and model	Power*	Battery capacity	Typical battery runtime	Battery warranty period	Number of batteries used in equipment
Lawn mower	<a href="#">Makita XML11CT1</a>	Self-propelled with speed up to 3 mph	4 × 18 V, 5 Ah	Up to 50 minutes with four batteries	3 years	2 (4 included in kit)
Leaf blower	<a href="#">RYOBI RY40480</a>	"More power than a 25cc gas blower" 110 mph maximum air speed	144 Wh	Up to 29 minutes	3 years	1
Pole Saw	<a href="#">Dewalt DCPS620M1</a>	6.5 meters per second chain speed (8-inch bar and chain)	<a href="#">80 Wh</a>	96 cuts/charge for 4x4 inch pine reference piece	<a href="#">3 years</a>	1
Pressure Washer	<a href="#">EGO POWER+ HPW3204-2</a>	3,200 psi at 1.2 gpm (up to 2 gpm)	2 × 56 V, 6 Ah	Up to 60 minutes	3 years	2
Pump	<a href="#">RYOBI RY20WP182K</a>	0.25 hp; 10 gpm at 0 ft	18 V, 2 Ah	Not published**	3 years	1
Riding mower	<a href="#">RYOBI RYRM8034</a>	"42 hp equivalent"	80 V, 10 Ah; 40 V, 12 Ah	Up to 4 acres/charge	5 years (80 V, if registered) 3 years (40 V)	7
Snow blower	<a href="#">RYOBI RY40890</a>	"More power than 123 cc gas"	40 V, 6 Ah	Up to 30 minutes	3 years	1

NA = not applicable

\*Rated power or manufacturer performance description

\*\*Information not published online or provided upon request

## Exhibit A - Additional Examples of Residential ZEE Available as of April 2024

Equipment type	Make and model	Power*	Battery capacity	Typical battery runtime	Battery warranty period	Number of batteries used in equipment
Snow blower	<a href="#">EGO POWER+ SNT2405</a>	"Throws snow up to 50 feet"	<a href="#">2 × 420 Wh</a>	<a href="#">60 minutes</a>	3 years	2
Snow blower	<a href="#">EGO POWER+ SNT2807</a>	"Throws snow up to 60 feet"	56 V, 12 Ah	27 minutes	5 years	2
Snowblower	<a href="#">Snow Joe 24V-X4-SB24</a>	"Throws snow up to 40 feet"	4 × 24 V, 12 Ah	30 minutes	2 years	4

NA = not applicable

\*Rated power or manufacturer performance description

\*\*Information not published online or provided upon request

## Exhibit A - Additional Examples of Professional ZEE Available as of April 2024

Equipment type	Make and model	Power*	Battery capacity	Typical battery runtime	Battery warranty period	Number of batteries used in equipment	Median number of batteries for typical work day per survey	Cost of batteries for typical work day per survey
Bunker Rake	<a href="#">Smithco Sand Star E</a>	83 Nm peak torque	8.2 kWh	Up to 8 hours	5 years	1	NA; Not evaluated in survey	NA; Not evaluated in survey
Brush Cutter	<a href="#">Echo eFORCE 56V X Series DSRM-2600UR2 with 5 Ah Battery</a>	"equal to a 25 cc gas-powered brushcutter"	<a href="#">252 Wh</a>	Up to 54 minutes	2 years	1	1	<a href="#">\$249.00</a>
Chainsaw	<a href="#">Stihl MSA 300 C-O</a>	"the most powerful battery chainsaw in the STIHL lineup"	<a href="#">337 Wh</a>	Up to 44 minutes	<a href="#">3 years</a>	1	2	<a href="#">\$759.98</a>
Edger	<a href="#">Husqvarna 525iECS with BLi300 battery</a>	"Power equivalent to a 25cc petrol machine"	<a href="#">337 Wh</a>	<a href="#">40 minutes</a>	<a href="#">2 years</a>	1	2	<a href="#">\$639.98</a>
Edger	<a href="#">Husqvarna 525iECS with BLi950X battery</a>	"Power equivalent to a 25cc petrol machine"	<a href="#">1,119.6 Wh</a>	<a href="#">135 minutes</a>	<a href="#">2 years</a>	1	1	<a href="#">\$1,499.99</a>

NA = not applicable

\*Rated power or manufacturer performance description

\*\*Information not published online or provided upon request

## Exhibit A - Additional Examples of Professional ZEE Available as of April 2024

Equipment type	Make and model	Power*	Battery capacity	Typical battery runtime	Battery warranty period	Number of batteries used in equipment	Median number of batteries for typical work day per survey	Cost of batteries for typical work day per survey
Generator Set	<a href="#">Goal Zero Yeti Pro 4000</a>	3,600 W (7,200 W surge)	4 kWh	Full size refrigerator (67 W) 51 hrs; Mini fridge (35 W) 97 hours; Laptop (51 Wh) 67 charges; Smart phone (12 Wh) 283 charges	5 years	1	NA; battery runtime depends on load	NA; battery runtime depends on load
Generator Set	<a href="#">Goal Zero Yeti Pro 4000 + 4 Tank PRO 4,000 expansion batteries</a>	3,600 W (7,200 W peak)	<a href="#">20 kWh</a>	NA; Depends on load	5 years	5	NA; battery runtime depends on load	NA; battery runtime depends on load
Generator Set	<a href="#">Oncore Energy hydrogen fuel cell (Bronze/Gold)</a>	4 kW base system; scalable to 20+ kW	Not published**	NA; Depends on load	Not published**	1	NA; battery runtime depends on load	NA; battery runtime depends on load

NA = not applicable

\*Rated power or manufacturer performance description

\*\*Information not published online or provided upon request

## Exhibit A - Additional Examples of Professional ZEE Available as of April 2024

Equipment type	Make and model	Power*	Battery capacity	Typical battery runtime	Battery warranty period	Number of batteries used in equipment	Median number of batteries for typical work day per survey	Cost of batteries for typical work day per survey
Generator Set	<a href="#">Bluetti AC200MAX</a>	2,200 W (4,800 W surge)	2,048 Wh	Refrigerator (150 W) 10 hrs; Light (10 W) 150+ hrs	4 years	1	NA; battery runtime depends on load	NA; battery runtime depends on load
Generator Set	<a href="#">Bluetti AC200MAX + 2 B300 expansion batteries</a>	2,200 W (4,800 W peak)	<a href="#">8.192 kWh</a>	Not published**	4 years	3	NA; battery runtime depends on load	NA; battery runtime depends on load
Generator Set	<a href="#">AtlasCopco ZBP-2000</a>	2 kVA	2,160 Wh	NA; Depends on load	Not published**	1	NA; battery runtime depends on load	NA; battery runtime depends on load
Generator Set	<a href="#">AtlasCopco ZPB-2000 (5 units in parallel)</a>	Not published**	10.8 kWh	NA; Depends on load	Not published**	5	NA; battery runtime depends on load	NA; battery runtime depends on load

NA = not applicable

\*Rated power or manufacturer performance description

\*\*Information not published online or provided upon request

## Exhibit A - Additional Examples of Professional ZEE Available as of April 2024

Equipment type	Make and model	Power*	Battery capacity	Typical battery runtime	Battery warranty period	Number of batteries used in equipment	Median number of batteries for typical work day per survey	Cost of batteries for typical work day per survey
Generator Set	<a href="#">Onyx Power R5</a>	4,000 W (7,000 W peak)	5,000 Wh	NA; Depends on load	Not published**	1	NA; battery runtime depends on load	NA; battery runtime depends on load
Generator Set	<a href="#">Onyx Power R5 + X5 expansion battery</a>	4,000 W (7,000 W peak)	10 kWh	NA; Depends on load	Not published**	2	NA; battery runtime depends on load	NA; battery runtime depends on load
Generator Set	<a href="#">Onyx Power R5 + X10 expansion battery</a>	4,000 W (7,000 W peak)	15 kWh	NA; Depends on load	Not published**	2	NA; battery runtime depends on load	NA; battery runtime depends on load
Lawn Mower	<a href="#">Greenworks 82LM21S-8DP with 82BD800 battery</a>	2.8 kW maximum (cutting motor); 3.4 kW peak (mower)	2 × 640 Wh	1.5 acres/charge or up to 90 minutes	<a href="#">2 years</a>	1 or 2	2	<a href="#">\$989.98</a>

NA = not applicable

\*Rated power or manufacturer performance description

\*\*Information not published online or provided upon request

## Exhibit A - Additional Examples of Professional ZEE Available as of April 2024

Equipment type	Make and model	Power*	Battery capacity	Typical battery runtime	Battery warranty period	Number of batteries used in equipment	Median number of batteries for typical work day per survey	Cost of batteries for typical work day per survey
Walk-behind (Golf Course) Greens Mower	<a href="#">John Deere 185 E-Cut</a>	18-inch cutting width	3.56 kWh	50,000 sq. ft./charge	<a href="#">Up to 4 years</a>	1	NA; battery runtime not published	NA; battery runtime not published
Lawn Mower	<a href="#">Toro Greensmaster e1021</a>	21-inch cutting width	1.51 kWh	Up to 44,000 sq. ft./charge	4 years	1	NA; battery runtime not published	NA; battery runtime not published
Leaf blower	<a href="#">Kress KC500.9</a>	35 N of air force	<a href="#">660 Wh</a>	<a href="#">15-61 minutes</a>	<a href="#">6 years</a>	1	1	<a href="#">\$1,399.99</a>
Pressure Washer	<a href="#">Tuffy Cleaning Systems</a>	2.2 gpm at 600 psi; Up to 4.2 gpm at 4,000 psi	24 kW and 250 Ah; 36 kW and 375 Ah; 48 kW and 500 Ah	Up to 30 hrs	5 years	1	1	NA; Battery included with equipment purchase
Pump	<a href="#">Milwaukee MX FUEL™ 1 HP 2" Submersible Pump Kit</a>	1 hp	72 V, 6 Ah	Up to 20 minutes (high mode); 2,000 gallons/charge	2 years	1	3	<a href="#">\$1,797.00</a>
Riding Mower	<a href="#">Mean Green Rival</a>	11.5 mph top speed	22 kWh	Up to 7 hours	5 years	1	NA; Integrated battery	NA; Integrated battery

NA = not applicable

\*Rated power or manufacturer performance description

\*\*Information not published online or provided upon request

## Exhibit A - Additional Examples of Professional ZEE Available as of April 2024

Equipment type	Make and model	Power*	Battery capacity	Typical battery runtime	Battery warranty period	Number of batteries used in equipment	Median number of batteries for typical work day per survey	Cost of batteries for typical work day per survey
Riding Mower	<a href="#">Mean Green NEMESIS</a>	"Equivalent to a 28 HP gas mower"	7 kWh	Up to 5 acres/ charge; Up to 2.25 hours	5 years	1	NA; Integrated battery	NA; Integrated battery
Riding Mower	<a href="#">Toro Greensmaster eTriFlex 3370</a>	1.1 kW (each of 3 reel motors)	10.77 kWh	Not published**	<a href="#">4 years</a>	8	NA; battery runtime not published	NA; battery runtime not published
Skid Steer Compact Utility Loader	<a href="#">Toro eDingo 500</a>	"81 inch hinge pin height while maintaining 515 lbs rated operating capacity"	13.57 kWh	Up to 8 hours	<a href="#">2 years</a>	1	NA; Not evaluated in survey	NA; Not evaluated in survey
Snow blower	<a href="#">Toro 39922T</a>	Throws snow up to 40 feet	60 V, 7.5 Ah	"clear up to a 12-parked-car driveway on a single charge" with one battery	<a href="#">3 years</a>	1 or 2	NA; battery runtime not published	NA; battery runtime not published
Snow blower	<a href="#">Greenworks 82SN24D-82DP</a>	6.6 kW peak	2 × 640 Wh	"Clear up to a 36-car driveway"	2 years	2	NA; battery runtime not published	NA; battery runtime not published
Sweeper	<a href="#">Toro Pro Sweep Debris Sweeper Model: 07068</a>	Hydraulic connection (8 gpm at 2,000 psi)	NA; hydraulic power	NA; hydraulic power	NA; hydraulic power	NA; hydraulic power	NA; Not evaluated in survey	NA; Not evaluated in survey

NA = not applicable

\*Rated power or manufacturer performance description

\*\*Information not published online or provided upon request



## Exhibit A - Additional Examples of Professional ZEE Available as of April 2024

Equipment type	Make and model	Power*	Battery capacity	Typical battery runtime	Battery warranty period	Number of batteries used in equipment	Median number of batteries for typical work day per survey	Cost of batteries for typical work day per survey
Sweeper	<a href="#">John Deere TC125</a>	Hydraulic connection (6 gpm at 2,000 psi)	NA; hydraulic power	NA; hydraulic power	NA; hydraulic power	NA; hydraulic power	NA; Not evaluated in survey	NA; Not evaluated in survey
Trimmer	<a href="#">DeWalt DCST972X1</a>	17-inch cutting swath	60 V, 3 Ah	Not published**	3 years	1	NA; battery runtime not published	NA; battery runtime not published

NA = not applicable

\*Rated power or manufacturer performance description

\*\*Information not published online or provided upon request

## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
<b>CARB has not met authorization criteria for technical feasibility; zero-emission leaf blowers are insufficient</b>	G. Knott, Outdoor Power Equipment Institute	20:19 - 21:9	The California Air Resources Board (CARB) disagrees with the commenters' conclusions. The commenter does not provide evidence that leaf blowers must be operated at full throttle to perform useful work. The commenter also does not provide evidence that operation at continuous full throttle until batteries or fuel tanks are drained is typical or representative. When using a leaf blower, an operator may choose to vary the throttle position depending on the material to be moved with the leaf blower.	Final statement of reasons ( <a href="#">FSOR</a> ), p. 583
<b>CARB has not addressed the costs of compliance, including cost of batteries needed</b>	G. Knott, Outdoor Power Equipment Institute	21:10 - 22:5	CARB's economic analysis assumed users would purchase enough batteries to complete a day of work with fully charged batteries at the start of the day, as described on page 39 of the Standardized Regulatory Impact Assessment ( <a href="#">SRIA</a> ). Average use times for each equipment type during a day of work were obtained from the SORE2020 emissions inventory report. Some users may require more batteries for longer use times, while others may require fewer. Information related to estimated battery usage is provided in Exhibit A, including the estimated cost for the batteries for the specific equipment based upon usage.	<a href="#">FSOR</a> , pp. 583-584
<b>Lead time does not comply with Clean Air Act section 202(a), technology does not exist for</b>	G. Knott, Outdoor Power Equipment Institute	25:12 - 26:11	Section 209(e)(2)(A) of the Clean Air Act does not impose a two-year lead time requirement on California's adoption of emission standards and other emission-related requirements for new off-road engines. Nevertheless, the regulation	<a href="#">FSOR</a> , pp. 375-378  Initial statement of reasons

## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
<p><b>generators and pressure washers to meet more stringent emission standards</b></p>			<p>provides sufficient lead time for generators and pressure washers, as required by section 202(a).</p> <p>The technological feasibility of the small off-road engine (SORE) regulations does not depend on manufacturers having already produced zero-emission equipment (ZEE) versions of every type of equipment that use SORE. Just as equipment manufacturers install similar engines in many equipment types, they may choose to install similar zero-emission power units that use the same batteries in many equipment types without the need to develop new technology. Engines certified in 2021 for sale or lease for use or operation in California already exhibit emissions below the model year (MY) 2024-2027 emission standards. These engines demonstrate the feasibility of the more stringent emission standards. Besides, lead time is calculated from the date the rule is adopted, not the date the standards take effect. The 2021 SORE amendments were adopted December 9, 2021, but the standards did not go into effect until MY 2024, allowing a minimum of two full years for compliance. CARB additionally offered manufacturers the opportunity to utilize its limited-term Executive Order (EO) certification option, which allowed them to certify MY 2024 engines to MY 2023 standards. Unlike regular EOs, these EOs terminate upon published authorization of the regulation, but they provide an additional buffer time as needed. Finally, generators and pressure washers do not have zero-emission standards until MY 2028, allowing <i>more than six years</i> for manufacturers to comply with zero-emission standards.</p>	<p>(<i>ISOR</i>), p. ES-8</p>

## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
			<p>Manufacturers have already certified pressure washers and generators to the MY 2024 requirements, showing they are capable of meeting the more stringent emission standards. As of March 12, 2024, 48 applications for generators and pressure washers have been certified. See Exhibit C for more details.</p>	
<p><b>Not enough time to transition mechanical system to electric by 2024</b></p>	<p>G. Lancina, Briggs and Stratton</p>	<p>28:15 - 29:7</p>	<p>The amendments approved by CARB for adoption in December 2021(2021 Amendments) do not require manufacturers to convert existing models of SORE equipment to ZEE. CARB's technological feasibility determination was based in part on the existence and cost of ZEE for many types of small off-road equipment. Manufacturers may choose to convert existing models from SORE to ZEE or may introduce new models of ZEE. Manufacturers' decisions to convert models to ZEE do not impact the technological feasibility of the 2021 Amendments.</p> <p>The 2021 Amendments set emission standards of zero, which may be met through the use of emission reduction credits.</p> <p>Chapter I.E of the <i>ISOR</i> discusses the availability and technological feasibility of ZEE. The commenters do not provide evidence that the 2021 Amendments require the use of technology beginning in 2024 that does not exist. Technologies used by ZEE, including electric motors, batteries, battery management systems, and other electronics, are prevalent and are used in small off-road equipment as well as equipment that are comparable to SORE equipment, as discussed in the ISOR.</p>	<p><i>FSOR</i>, pp. 610-611</p>

## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
<p><b>Only one professional zero-emission stand-on/ride on mower available, takes four years to source domestic battery, not enough time to convert all products to ZEE</b></p>	<p>G. Lancina, Briggs and Stratton</p>	<p>29:11-22</p>	<p>The SORE regulations and 2021 Amendments apply to new engines manufactured for sale, sold, or offered for sale in California, or introduced, delivered or imported into California for introduction into commerce. Gardeners, landscapers, and other professionals may continue to use and repair their current SORE equipment until the end of its useful life.</p> <p>The 2021 Amendments do not require manufacturers to convert existing models of SORE equipment to ZEE. CARB's technological feasibility determination was based in part on the existence and cost of ZEE for many types of small off-road equipment, including professional-grade equipment. Manufacturers may choose to convert existing models from SORE to ZEE or may introduce new models of ZEE. Manufacturers may meet emission standards of zero through the use of emission reduction credits. Manufacturers' decisions to convert models to ZEE are beyond the scope of the 2021 Amendments and do not impact the technological feasibility of the 2021 Amendments.</p> <p><i>ISOR</i> section I.E.2.ii provides a few examples of zero-emission, zero turn-radius riding mowers from Gravely and Mean Green. In addition, Exhibit A provides several more examples of professional riding mowers that are currently on the market with similar or better performance characteristics compared to gasoline-powered riding mowers.</p>	<p><i>FSOR</i>, pp. 273, 611</p>

## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
<p><b>Battery run time and charging needs challenge commercial landscapers</b></p>	<p>G. Lancina, Briggs and Stratton</p>	<p>30:1 - 13</p>	<p>The SORE regulations and 2021 Amendments apply to new engines manufactured for sale, sold, or offered for sale in California, or introduced, delivered or imported into California for introduction into commerce. Gardeners, landscapers, and other professionals may continue to use and repair their current SORE equipment until the end of its useful life.</p> <p>Landscapers and other users may choose to use higher-capacity batteries, which could reduce the number of chargers and batteries that an organization would need. CARB did not assume landscapers would need to or be able to charge batteries during a work day. The economic analysis assumed users would purchase enough batteries to complete a day of work, as described on page 39 of the <i>SRIA</i>.</p>	<p><i>FSOR</i>, pp. 273-274, 351-352</p>
<p><b>Cost, performance, availability, and infrastructure issues for commercial landscapers</b></p>	<p>T. Stovall, National Association of Landscape Professionals</p>	<p>33:3 - 8; 33:21 - 34:8</p>	<p>While upfront costs for landscapers to purchase ZEE are significant, savings in ongoing costs can exceed the upfront costs, as described in Chapter VII of the <i>ISOR</i>, resulting in overall cost savings for the purchase and use of ZEE. Additionally, battery prices are projected to decrease further than expected from the <i>ISOR</i>, as further described in CARB's supplemental comment letter.</p> <p>The SORE regulations and 2021 Amendments apply to new engines manufactured for sale, sold, or offered for sale in California, or introduced, delivered or imported into California for introduction into commerce. Gardeners, landscapers, and</p>	<p><i>FSOR</i>, pp. 273-274, 351-352, 582</p>

## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
			<p>other professionals may continue to use and repair their current SORE equipment until the end of its useful life.</p> <p>As described in detail in <a href="#">ISOR</a> section I.E and further evaluated in CARB's supplemental comment letter, the availability, level of performance, number of brands, and number of zero-emission equipment options for both residential and professional use have increased greatly and continue to do so today. Battery and electric motor technology has advanced rapidly in recent years, while costs have declined. For the most common types of SORE equipment, there are ZEE equivalents available in the market with similar or better performance characteristics and lifetime. Exhibit A provides more example of ZEE available today for both residential and professional users.</p> <p>The 2021 Amendments do not require anyone to upgrade their electrical service. Smart charging switches are an option that can allow for the charging of many batteries on just one electrical circuit without exceeding the current rating of the circuit. Landscapers and other users may choose to use higher-capacity batteries, which could reduce the number of chargers and batteries that an organization would need. CARB did not assume landscapers would need to or be able to charge batteries during a work day. The economic analysis assumed users would purchase enough batteries to complete a day of work, as described on page 39 of the <a href="#">SRIA</a>.</p> <p>CARB's supplemental comment letter provides several examples of new smart charging switch solutions.</p>	

## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
<p><b>Delay zero-emission requirements by two years for professional users, provide more incentives</b></p>	<p>T. Stovall, National Association of Landscape Professionals</p>	<p>34:9 - 35:3</p>	<p>The SORE regulations and 2021 Amendments apply to new engines manufactured for sale, sold, or offered for sale in California, or introduced, delivered or imported into California for introduction into commerce. Gardeners, landscapers, and other professionals can continue to use and repair their current SORE equipment until the end of its life.</p> <p>Delaying implementation for SORE equipment used by professionals would fail to maximize health benefits that could be achieved and would make less progress toward statewide commitments. Furthermore, there is no legal basis for denying authorization for professional equipment. Equipment used by professionals ("commercial-grade equipment") typically have a shorter life cycle and higher use times than residential SORE equipment. On average, landscapers use a lawn mower 240 hours per year, while residents use a lawn mower 19 hours per year. Therefore, emissions from a piece of commercial equipment are often higher than those from a piece of residential equipment. Emissions from landscapers' equipment are 21% of the overall emissions from SORE.<sup>1</sup> Using ZEE landscaping and other ZEE commercial equipment is important for statewide emissions reductions. The noncompliance rate with current evaporative emission standards is high (~40% since 2015, see ISOR section II.A.1), so previously expected emission reductions will not be realized.</p>	<p><i>FSOR</i>, pp. 273, 276</p>

<sup>1</sup> California Air Resources Board. *"2020 Emissions Model for Small Off-Road Engines - SORE2020."* 2020.

[https://ww2.arb.ca.gov/sites/default/files/2020-09/SORE2020\\_Technical\\_Documentation\\_2020\\_09\\_09\\_Final\\_Cleaned\\_ADA.pdf](https://ww2.arb.ca.gov/sites/default/files/2020-09/SORE2020_Technical_Documentation_2020_09_09_Final_Cleaned_ADA.pdf)



## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
			<p>Potential emission impacts from ongoing noncompliance would still not be addressed if implementation of the 2021 Amendments were delayed for commercial SORE equipment.</p> <p>CARB's supplemental comment letter provides more details about current and potential incentives such as the Carl Moyer program and the Commercial Clean Vehicle Credit program, respectively. CARB encourages landscapers to reach out to their legislators to emphasize the demand and importance of funding opportunities for landscaping equipment.</p>	
<p><b>Concerns regarding impacts to golf industry. Limited zero-emission alternatives.</b></p>	<p>J. Jensen, Golf Course Superintendents Association of America</p>	<p>37:1 - 7</p>	<p>The 2021 Amendments apply to new engines manufactured for sale, sold, or offered for sale in California, or introduced, delivered or imported into California for introduction into commerce. Gardeners, landscapers, and other professionals may continue to use and repair their current SORE equipment until the end of its useful life.</p> <p>As described in detail in <i>ISOR</i> section I.E and further evaluated in CARB's supplemental comment letter, the level of performance, number of brands, and number of zero-emission equipment options for both residential and professional use have increased greatly and continue to do so today. Battery and electric motor technology has advanced rapidly in recent years, while costs have declined. For the most common types of SORE equipment, there are ZEE equivalents available in the market with similar or better performance characteristics and lifetime.</p>	<p><i>FSOR</i>, pp. 273-274</p>

## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
			<p>Bunker rakes are used to maintain golf courses to smooth the surface of bunkers, also known as sand traps. As described in Exhibit A, Smithco offers an industrial-grade electric bunker rake, the Sand Star E 48V AC, that can run up to eight hours on a single charge.</p> <p>Another important type of equipment used to maintain golf courses that was not discussed during 2021 rulemaking is turf aerators, which perforate the soil with small holes to allow air, water and nutrients to penetrate the grass roots to grow vigorous lawns. Toro offers zero-emission aerators that may be powered by tow vehicles with power take-offs.<sup>2</sup></p>	
<p><b>Commercial equipment is unique, different performance, and runtime. Cannot transition to zero by 2024</b></p>	<p>P. Hanz, Truck and Engine Manufactures Association</p>	<p>41:16 - 20; 42:4 - 18</p>	<p>The SORE regulations and 2021 Amendments apply to new engines manufactured for sale, sold, or offered for sale in California, or introduced, delivered or imported into California for introduction into commerce. The SORE regulations require new engines to be certified and labeled to meet emission standards and other requirements. CARB regulates the engines, but does not regulate the use of SORE equipment. People, including commercial users, may continue to use and repair their current SORE equipment until the end of its useful life (e.g., until the SORE equipment breaks or people decide to upgrade equipment). There is no scheduled date of</p>	<p><i>FSOR</i>, pp. 135, 611</p>

<sup>2</sup> Toro. *"Aerating Equipment."* Accessed on March 27, 2024. <https://www.toro.com/en/sports-fields-municipalities/aerators>

## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
			<p>elimination for SORE equipment that California residents and businesses currently own.</p> <p>The 2021 Amendments do not require manufacturers to convert existing models of SORE equipment to ZEE. CARB's technological feasibility determination was based in part on the existence and cost of ZEE for many types of small off-road equipment, including professional-grade equipment. Manufacturers may choose to convert existing models from SORE to ZEE or may introduce new models of ZEE. Manufacturers may also meet emission standards of zero through the use of emission reduction credits. Manufacturers' decisions to convert models to ZEE are beyond the scope of the 2021 Amendments and do not impact the technological feasibility of the 2021 Amendments.</p> <p>Larger pressure washers and portable generators have a longer phase-in schedule to allow the market to mature. Starting with model year 2024, both equipment types are subject to more stringent emission standards, and Exhibit C provides details of engines and equipment certified to the more stringent standards.</p>	
<p><b>SORE amendments do not meet technological feasibility requirements of</b></p>	<p>P. Hanz, Truck and Engine Manufactures Association</p>	<p>43:5 - 9</p>	<p>Section 202(a) of the Clean Air Act requires CARB provide sufficient lead time for manufacturers to comply with the 2021 SORE amendments. CARB has provided sufficient lead time for manufacturers to come into compliance with the new standards. The U.S. Environmental Protection Agency (U.S. EPA) calculates lead time from the date the rule was</p>	<p><i>FSOR</i>, pp. 375-378; Supp. Comment Ltr., Secs. III &amp; X</p>

## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
<b>CAA section 202(a)(2)</b>			promulgated or adopted to the date the standards take effect. <sup>3</sup> In this case, the 2021 SORE amendments were adopted by the Board on December 9, 2021 but the emissions standards did not take effect until the MY 2024, building in at least two full years of lead time. Additionally, CARB has offered a limited-term EO program that allows manufacturers to certify MY 2024 engines to MY 2023 standards until U.S. EPA publishes CARB's authorization for the amendments. Between the lead time built into the regulation and the optional limited-term EO program, CARB has provided more than two full years for manufacturers to come into compliance, which exceeds the staff recommendation contained in the ISOR.	
<b>Commercial challenges for golf course superintendents include charging infrastructure costs, performance, durability and shelf life, charging time</b>	M. Lee, The Golf Course Superintendents Association of America	52:4 - 53:1	The SORE regulations and 2021 Amendments apply to new engines manufactured for sale, sold, or offered for sale in California, or introduced, delivered or imported into California for introduction into commerce. The SORE regulations require new engines to be certified and labeled to meet emission standards and other requirements. CARB regulates the engines, but does not regulate the use of SORE equipment. People can continue to use and repair their current SORE equipment until the end of its life (e.g., until the SORE equipment breaks or people decide to upgrade equipment).	<i>FSOR</i> , pp. 135, 273-274, 351-352, 611

<sup>3</sup> 88 Fed. Reg. 20711, fn. 208 (April 6, 2023) "EPA evaluates the lead time associated with CARB's regulation by examining the date of CARB's adoption of the regulation and when manufacturers are required to meet the regulation."

## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
			<p>There is no scheduled date of elimination for SORE equipment that California residents and businesses currently own.</p> <p>The 2021 Amendments do not require manufacturers to convert existing models of SORE equipment to ZEE. CARB's technological feasibility determination was based in part on the existence and cost of ZEE for many types of small off-road equipment, including professional-grade equipment. Manufacturers may choose to convert existing models from SORE to ZEE or may introduce new models of ZEE. Manufacturers may meet emission standards of zero through the use of emission reduction credits. Manufacturers' decisions to convert models to ZEE are beyond the scope of the 2021 Amendments and do not impact the technological feasibility of the 2021 Amendments.</p> <p>The 2021 Amendments do not require anyone to upgrade their electrical service. Smart charging switches are an option that can allow for the charging of many batteries on just one electrical circuit without exceeding the current rating of the circuit. Landscapers and other users may choose to use higher-capacity batteries, which could reduce the number of chargers and batteries that an organization would need. CARB did not assume landscapers would need to or be able to charge batteries during a work day. The economic analysis assumed users would purchase enough batteries to complete a day of work, as described on page 39 of the <a href="#">SRIA</a>.</p> <p>CARB's supplemental comment letter provides several examples of new smart charging switch solutions.</p>	

## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
<p><b>Specific equipment not available for zero-emission</b></p>	<p>M. Lee, The Golf Course Superintendents Association of America</p>	<p>53:2 - 12</p>	<p>The SORE regulations and 2021 Amendments apply to new engines manufactured for sale, sold, or offered for sale in California, or introduced, delivered or imported into California for introduction into commerce. The SORE regulations require new engines to be certified and labeled to meet emission standards and other requirements. CARB regulates the engines, but does not regulate the use of SORE equipment. People can continue to use and repair their current SORE equipment until the end of its life (e.g., until the SORE equipment breaks or people decide to upgrade equipment). There is no scheduled date of elimination for SORE equipment that California residents and businesses currently own.</p> <p>As described in detail in <a href="#">ISOR</a> section I.E and further evaluated in CARB's supplemental comment letter, the level of performance, number of brands, and number of zero-emission equipment options for both residential and professional use have increased greatly and continue to do so today. Battery and electric motor technology has advanced rapidly in recent years, while costs have declined. For the most common types of SORE equipment, there are ZEE equivalents available in the market with similar or better performance characteristics and lifetime.</p> <p>As described in Exhibit A, Smithco offers an industrial-grade electric bunker rake, the Sand Star E 48V AC, that can run up to eight hours on a single charge.</p>	<p><a href="#">FSOR</a>, pp. 135, 280, 610</p>

## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
			<p>Toro's ProCore 648s<sup>4</sup> series turf aerator and John Deere's AerCore 800<sup>5</sup> aerator are powered by SORE. The technology used to power these models is similar to what is used for other small off-road equipment. New technology would not have to be developed to power these aerators. Toro offers zero-emission aerators that may be powered by tow vehicles with power take-offs. Toro and John Deere also offer zero-emission walk-behind and riding mowers, debris sweepers, and turf collection systems. Many equipment types used to maintain golf courses are powered by engines that are not subject to the SORE regulations.</p>	
<p><b>Professional challenges are charging, battery transportation regulations, battery recycling restrictions</b></p>	<p>E. Ashcroft, Stihl</p>	<p>71:20 - 72:2</p>	<p>The SORE regulations and 2021 Amendments apply to new engines manufactured for sale, sold, or offered for sale in California, or introduced, delivered or imported into California for introduction into commerce. The SORE regulations require new engines to be certified and labeled to meet emission standards and other requirements. CARB regulates the engines, but does not regulate the use of SORE equipment. People can continue to use and repair their current SORE equipment until the end of its life (e.g., until the SORE equipment breaks or people decide to upgrade equipment). There is no scheduled date of elimination for SORE equipment that California residents and businesses currently own.</p>	<p><i>FSOR</i>, pp. 135, 352, 357, 360</p>

<sup>4</sup> Toro. "ProCore 648s." Accessed on March 27, 2024. <https://www.toro.com/en/product/09960>

<sup>5</sup> John Deere. "Aercore 800." Accessed on March 27, 2024. <https://www.deere.com/en/aeration-equipment/aercore-800-aerator/>

## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
			<p>Landscapers and other users may choose to use higher-capacity batteries, which could reduce the number of chargers and batteries that an organization would need. CARB did not assume landscapers would need to or be able to charge batteries during a work day. The economic analysis assumed users would purchase enough batteries to complete a day of work, as described on page 39 of the <i>SRIA</i>.</p> <p>Battery storage, packaging, air transport, UN classification scheme, marking, and labeling are beyond the scope of the 2021 Amendments. The commenters do not provide evidence that batteries for ZEE cannot be transported as needed for retail distribution, use by equipment owners, and recycling at the end of the batteries' life. In addition to the details in the FSOR, CalRecycle has a website to help people locate drop-off locations to recycle various materials, including batteries.<sup>6</sup></p> <p>Disposal of any portion of equipment, including batteries, would be subject to, and be in compliance with existing laws and regulations governing solid waste, such as California's Universal Waste Rule.<sup>7</sup> That is, disposal of used batteries into landfills is prohibited; however, they could be recycled, refurbished, or reused. To meet an increased demand of recycling, refurbishing, or reusing batteries, existing facilities, are anticipated to accommodate battery recycling activities, as described in the ISOR. Since 2021 rulemaking, staff found that</p>	

<sup>6</sup> CalRecycle. *"Where to Recycle."* Accessed on March 27, 2024. <https://calrecycle.ca.gov/Recycle/>

<sup>7</sup> Cal. Code Regs., tit. 22, Chapter 23, sections 66273.1 - 66273.89.



## Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

### Technological and Economic Feasibility

Summary of Objection	Commentor (Name, Affiliation)	Transcript citation (page: line)	CARB's Response	Citation and link to CARB's Response
			<p>manufacturers, such as Stihl and Husqvarna, work with Call2Recycle where landscape professionals can drop off batteries at the end of their service life. EGO partners with Rechargeable Battery Recycling Corporation to help landscapers locate drop boxes to recycle batteries.<sup>8</sup></p>	
<p><b>Removing the design certification option and requiring performance certification increases costs without benefits</b></p>	<p>E. Ashcroft, Stihl</p>	<p>72:8 - 73:10</p>	<p>Requiring performance certification is necessary to ensure engines meet the more stringent emission standards and support the effective inclusion of hot soak emissions in the emission standards. The 2021 Amendments specify revisions to section 2754(a) and add a new subsection 2754(d) that, beginning with MY 2024, would require manufacturers to demonstrate compliance with evaporative emission standards that incorporate hot soak emissions and to submit data showing that hot soak plus diurnal emissions will not exceed the new emission standards prior to certification.</p> <p>CARB disagrees with the assertion that removing design certification would prevent manufacturers from using exhaust emission credits. Amendments to section 2754.1, certification averaging, banking, and trading (ABT) for evaporative emission credits, are discussed on pages 229-236 of the <i>ISOR</i>. All engines certified to the diurnal or hot soak plus diurnal emission standards specified in section 2754(a) may participate in the ABT program for evaporative emissions.</p>	<p><i>FSOR</i>, pp. 496-498</p>

<sup>8</sup> The Edge. *"The Shift from Gas to Battery."* 2023. <https://blog.landscapeprofessionals.org/the-shift-from-gas-to-battery/>

# Exhibit B - CARB Responses to the U.S. EPA Hearing Comments

## Technological and Economic Feasibility

**Exhibit C - Engine and Evaporative Families Certified to Model Year 2024 Emission Standards as of March 2024**

This workbook, Exhibit C, provides details of CARB-certified model year 2024 engine and evaporative families used in pressure washers and portable generators that meet the new, more stringent model year 2024 emission standards. The tab labeled "Exhaust" lists the engine families meeting the cleaner exhaust emission standards (hydrocarbons plus oxides of nitrogen in grams per kilowatt-hour). The tab labeled "Evaporative" lists evaporative families meeting the cleaner evaporative emission standards (grams of organic material hydrocarbon equivalent per test) for hot soak plus diurnal emissions. Information is derived from CARB Executive Orders approved on or before March 12, 2024.

As described in California Code of Regulations, title 13, section 2403(b)(1), footnote (1), "Class I" means small off-road engines greater than 65 cc to less than 225 cc in displacement, and "Class II" means small off-road engines greater than or equal to 225 cc in

## Exhibit C - Engine Families Certified to Model Year 2024 Exhaust Emission Standards as of March 2024

Manufacturer	Family name	Equipment type	Using credits to certify?	Executive Order Number*	Maximum power rating	Engine disp. (cc)	Class**	MY 2024 Exhaust standard	Certification level
Honda Motor Co., Ltd.	RHNXS.1311CA	Generator Set	No	U-U-001-1097	4.3 kW	131	I	6.0	3.2
Cummins Inc.	RCEXS.2242LC	Generator Set	No	U-U-008-0333	3.3 kW	224	I	6.0	2.8
Cummins Inc.	RCEXS.6532LC	Generator Set	Yes	U-U-008-0334	9.57 kW, 8.47 kW	653	II	3.0	3.1
Cummins Inc.	RCEXS.2242IC	Generator Set	Yes	U-U-008-0335	3.5 kW	224	I	6.0	5.8
Cummins Inc.	RCEXS.3892IC	Generator Set	No	U-U-008-0336	5.5 kW	389	II	3.0	0.5
Cummins Inc.	RCEXS.6532IC	Generator Set	Yes	U-U-008-0337	10.2 kW	653	II	3.0	4.3
Jiangsu Jianghuai Engine Co., Ltd.	RJDGS.2081DP	Generator Set	No	U-U-068-0437	4.4 kW	208	I	6.0	3.9
Jiangsu Jianghuai Engine Co., Ltd.	RJDGS.3062DP	Generator Set	No	U-U-068-0438	7.0 kW	306	II	3.0	1.5
Jiangsu Jianghuai Engine Co., Ltd.	RJDGS.4202DP	Generator Set	No	U-U-068-0439	9.0 kW	420	II	3.0	1.9
Jiangsu Jianghuai Engine Co., Ltd.	RJDGS.2262DP	Pressure Washer	No	U-U-068-0440	4.8 kW	226	II	3.0	1.3

\*Issued by 3/12/24

\*\*CCR, tit. 13, sec. 2403(b)(1)

arb.ca.gov

1001 I Street • P.O. Box 2815 • Sacramento, California 95812

helpline@arb.ca.gov 2

## Exhibit C - Engine Families Certified to Model Year 2024 Exhaust Emission Standards as of March 2024

Manufacturer	Family name	Equipment type	Using credits to certify?	Executive Order Number*	Maximum power rating	Engine disp. (cc)	Class**	MY 2024 Exhaust standard	Certification level
Chongqing Zongshen General Power Machine Co., Ltd.	RCZHS.2241HC	Generator Set	No	U-U-082-0620	4.6 kW	224	I	6.0	4.1
Chongqing Zongshen General Power Machine Co., Ltd.	RCZHS.2241HV	Generator Set	No	U-U-082-0622	5.2 kW	224	I	6.0	5.4
Chongqing Zongshen General Power Machine Co., Ltd.	RCZHS.3022DV	Generator Set	No	U-U-082-0623	6.8 kW	302	II	3.0	2.5
Chongqing Dajiang Power Equipment Co., Ltd.	RCDPS.4572EA	Generator Set	No	U-U-105-0534	10 kW, 9.4 kW	457, 420	II	3.0	1.7
Chongqing Dajiang Power Equipment Co., Ltd.	RCDPS.4572EG	Generator Set	No	U-U-105-0535	10 kW, 9.4 kW, 9 kW, 8.46 kW, 8 kW, 7.52 kW	457, 420	II	3.0	1.4

\*Issued by 3/12/24

\*\*CCR, tit. 13, sec. 2403(b)(1)

## Exhibit C - Engine Families Certified to Model Year 2024 Exhaust Emission Standards as of March 2024

Manufacturer	Family name	Equipment type	Using credits to certify?	Executive Order Number*	Maximum power rating	Engine disp. (cc)	Class**	MY 2024 Exhaust standard	Certification level
Chongqing Dajiang Power Equipment Co., Ltd.	RCDPS.2241EA	Generator Set	No	U-U-105-0536	4.75 kW, 4.20 kW	224, 212	I	6.0	3.6
Chongqing Dajiang Power Equipment Co., Ltd.	RCDPS.2241EG	Generator Set	No	U-U-105-0537	4.75 kW, 4.3 kW, 4.2 kW, 3.8 kW, 3.4 kW	224, 212	I	6.0	3.6
Chongqing Dajiang Power Equipment Co., Ltd.	RCDPS.2241GB	Generator Set	No	U-U-105-0538	4.75 kW, 4.2 kW	224, 212	I	6.0	2.7
Chongqing Dajiang Power Equipment Co., Ltd.	RCDPS.2241GT	Generator Set	No	U-U-105-0539	4.75 kW, 4.3 kW, 4.2 kW, 3.8 kW, 3.4 kW	224, 212	I	6.0	3.2
Chongqing Dajiang Power Equipment Co., Ltd.	RCDPS.2982EA	Generator Set + Pressure Washer	No	U-U-105-0540	6.8 kW, 6.25 kW	298, 274	II	3.0	1.8

\*Issued by 3/12/24

\*\*CCR, tit. 13, sec. 2403(b)(1)

arb.ca.gov

1001 I Street • P.O. Box 2815 • Sacramento, California 95812

helpline@arb.ca.gov 4

## Exhibit C - Engine Families Certified to Model Year 2024 Exhaust Emission Standards as of March 2024

Manufacturer	Family name	Equipment type	Using credits to certify?	Executive Order Number*	Maximum power rating	Engine disp. (cc)	Class**	MY 2024 Exhaust standard	Certification level
Chongqing Dajiang Power Equipment Co., Ltd.	RCDPS.2982EG	Generator Set + Pressure Washer	No	U-U-105-0541	6.8 kW, 6.25 kW, 6.12 kW, 5.63 kW, 5.50 kW, 5.08 kW	298, 274	II	3.0	1.9
Chongqing Dajiang Power Equipment Co., Ltd.	RCDPS.5502EA	Generator Set + Pressure Washer	No	U-U-105-0542	12.5 kW, 12 kW	550	II	3.0	1.2
Chongqing Dajiang Power Equipment Co., Ltd.	RCDPS.5502EG	Generator Set + Pressure Washer	No	U-U-105-0543	12.5 kW, 12 kW, 11.25 kW, 10.08 kW, 10 kW, 9.6 kW	550, 500	II	3.0	1.4
Loncin Motor Co., Ltd.	RCGPS.2121DK	Generator Set	No	U-U-145-0646	4.5 kW	212	I	6.0	4.7
Loncin Motor Co., Ltd.	RCGPS.4202DK	Generator Set	No	U-U-145-0647	9.2 kW	420	II	3.0	2.3

\*Issued by 3/12/24

\*\*CCR, tit. 13, sec. 2403(b)(1)

arb.ca.gov

1001 I Street • P.O. Box 2815 • Sacramento, California 95812

helpline@arb.ca.gov 5

## Exhibit C - Engine Families Certified to Model Year 2024 Exhaust Emission Standards as of March 2024

Manufacturer	Family name	Equipment type	Using credits to certify?	Executive Order Number*	Maximum power rating	Engine disp. (cc)	Class**	MY 2024 Exhaust standard	Certification level
Loncin Motor Co., Ltd.	RCGPS.2231DK	Generator Set	No	U-U-145-0650	4.7 kW	223	I	6.0	4.9
Chongqing Am Pride Power & Machinery Co., Ltd.	RCPPS.2231DP	Generator Set	No	U-U-164-0189	4.6 kW, 4.2 kW	223	I	6.0	4.9
Chongqing Am Pride Power & Machinery Co., Ltd.	RCPPS.4592DP	Generator Set	No	U-U-164-0190	10 kW, 9 kW, 7.5 kW	459	II	3.0	1.2
Chongqing Rato Technology Co., Ltd.	RCRPS.2241CA	Generator Set	No	U-U-169-0596	5.3 kW, 5.0 kW	224	I	6.0	5.0
Chongqing Rato Technology Co., Ltd.	RCRPS.4202CA	Generator Set	No	U-U-169-0597	9.6 kW, 8.8 kW	420	II	3.0	2.2
Chongqing Rato Technology Co., Ltd.	RCRPS.5002CA	Generator Set	No	U-U-169-0598	12.5 kW, 10.5 kW	500	II	3.0	2.4
Zhejiang Constant Engine Mading Co., Ltd.	RZCES.4392GB	Generator Set	No	U-U-243-0109	9.5 kW	439	II	3.0	2.2

\*Issued by 3/12/24

\*\*CCR, tit. 13, sec. 2403(b)(1)

arb.ca.gov

1001 I Street • P.O. Box 2815 • Sacramento, California 95812

helpline@arb.ca.gov 6



## Exhibit C - Engine Families Certified to Model Year 2024 Exhaust Emission Standards as of March 2024

Manufacturer	Family name	Equipment type	Using credits to certify?	Executive Order Number*	Maximum power rating	Engine disp. (cc)	Class**	MY 2024 Exhaust standard	Certification level
Zhejiang Constant Engine Mading Co., Ltd.	RZCES.1931GE	Generator Set	No	U-U-243-0110	4.2 kW, 3.8 kW	193, 171	I	6.0	5.1
Zhejiang Constant Engine Mading Co., Ltd.	RZCES.4592GE	Generator Set	No	U-U-243-0111	10.5 kW	459	II	3.0	2.3

\*Issued on or before March 12, 2024

\*\*[CCR, tit. 13, sec. 2403\(b\)\(1\)](#)

\*Issued by 3/12/24

\*\*[CCR, tit. 13, sec. 2403\(b\)\(1\)](#)

[arb.ca.gov](http://arb.ca.gov)

1001 I Street • P.O. Box 2815 • Sacramento, California 95812

[helpline@arb.ca.gov](mailto:helpline@arb.ca.gov) 7

## Exhibit C - Evaporative Families Certified to Model Year 2024 Evaporative Emission Standards as of March 2024

Manufacturer	Family name	Equipment type	Using credits to certify?	Executive Order Number*	Class**	MY 2024 Evaporative Standard	Certification level
Honda Motor Co., Ltd.	HNXCMB1A	Generator Set	No	U-U-001-1098	I	0.60	0.20
Jiangsu Jianghuai Engine Co., Ltd.	JDGCM2081DP	Generator Set	No	U-U-068-0441	I	0.60	0.50
Jiangsu Jianghuai Engine Co., Ltd.	JDGCM2262DP	Pressure Washer	No	U-U-068-0442	II	0.70	0.50
Jiangsu Jianghuai Engine Co., Ltd.	JDGCM4202DP	Generator Set	No	U-U-068-0443	II	0.70	0.45
Chongqing Zongshen General Power Machine Co., Ltd.	CZHCMHC3	Generator Set	No	U-U-082-0621	I	0.60	0.43
Chongqing Dajiang Power Equipment Co., Ltd.	CDPCM22241EA	Generator Set	No	U-U-105-0544	I	0.60	0.44
Chongqing Dajiang Power Equipment Co., Ltd.	CDPCM22241GB	Generator Set	No	U-U-105-0545	I	0.60	0.50
Chongqing Dajiang Power Equipment Co., Ltd.	CDPCM22982EA	Generator Set + Pressure Washer	No	U-U-105-0546-1	II	0.70	0.48

\*Issued by 3/12/24

\*\*CCR, tit. 13, sec. 2403(b)(1)

arb.ca.gov

1001 I Street • P.O. Box 2815 • Sacramento, California 95812

helpline@arb.ca.gov 8

## Exhibit C - Evaporative Families Certified to Model Year 2024 Evaporative Emission Standards as of March 2024

Manufacturer	Family name	Equipment type	Using credits to certify?	Executive Order Number*	Class**	MY 2024 Evaporative Standard	Certification level
Chongqing Dajiang Power Equipment Co., Ltd.	CDPCM24572EA	Generator Set + Pressure Washer	No	U-U-105-0547-1	II	0.70	0.11
Chongqing Dajiang Power Equipment Co., Ltd.	CDPCM25502EA	Generator Set + Pressure Washer	No	U-U-105-0548-1	II	0.70	0.51
Loncin Motor Co., Ltd.	CGPCM212DK	Generator Set	No	U-U-145-0648	I	0.60	0.13
Loncin Motor Co., Ltd.	CGPCM420DK	Generator Set	No	U-U-145-0649	II	0.70	0.24
Zhejiang Constant Engine Mading Co., Ltd.	ZCECM1H	Generator Set	No	U-U-243-0117	I	0.6	0.49
Zhejiang Constant Engine Mading Co., Ltd.	ZCECM2H	Generator Set	No	U-U-243-0118	II	0.70	0.51

\*Issued by 3/12/24

\*\*CCR, tit. 13, sec. 2403(b)(1)

arb.ca.gov

1001 I Street • P.O. Box 2815 • Sacramento, California 95812

helpline@arb.ca.gov 9