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**Mainspring Energy Comments on Senate Bill 423 Emerging
Renewable and Firm Zero Carbon Resources Workshop**

Additional submitted attachment is included below.

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December 1, 2023

California Energy Commission
Docket Unit, MS-4
Docket No. 23-ERDD-01
715 P Street
Sacramento, California 95814

Re: *Senate Bill 423 Emerging Renewable and Firm Zero Carbon Resources (21-ESR-01)*

Mainspring Energy, Inc. (“Mainspring”) hereby submits these comments on the Senate Bill (“SB”) 423 Emerging Renewable and Firm Zero Carbon Resources Workshop (“workshop”) that took place on November 17, 2023.¹

About Mainspring

Driven by its vision of the affordable, reliable, net-zero carbon grid of the future, Mainspring has developed and commercialized a new power generation technology —the linear generator— delivering local power that is dispatchable and fuel-flexible. Mainspring’s linear generator offers a unique non-combustion capacity and energy solution that simultaneously addresses the critical need of reducing greenhouse gas and criteria pollutant emissions, while also enhancing grid reliability and resilience.

Modular and scalable, Mainspring’s linear generators can be deployed near load, either customer- or grid-sited. Mainspring’s inverter-based technology offers a full range of valuable grid benefits including fast (and unlimited daily) starts/stops, a wide dispatch range from minimum to maximum load, quick ramping, and in many cases on-site fuel storage which allows linear generators to firm renewables for short or extended periods of time, thereby facilitating the continued rapid adoption of a reliable renewable energy grid. Our locally-sited linear generators add capacity and resilience to the grid while also providing enhanced flexibility to help avoid renewable curtailment.² Finally, by virtue of their modular size (20.5’ x 8.5’ x 9.5’), linear generators are space- and land-efficient and can be sited in load pockets – deferring expensive transmission & distribution investment.

¹ In these comments, Mainspring refers to the California Air Resources Board, the California Energy Commission, and the California Public Utilities Commission as the “Joint Agencies,” consistent with SB 100’s delegation of reporting obligations to these agencies.

² For additional information on technical specifications and performance benefits, visit <https://www.mainspringenergy.com/technology/>.

I. Executive Summary

Mainspring thanks the California Energy Commission (“Commission”) for the opportunity to provide comments on the workshop presentation. Through these comments we assert:

- Linear generators are a commercialized clean firm technology already in deployment;
- Hydrogen and renewable natural gas –alongside clean ammonia– are an essential means of providing clean firm power for California’s future grid.

II. Linear Generators are a Commercialized Clean Firm Technology Already in Deployment in California

As illustrated in the workshop presentation, clean firm power has an important role to play in creating California’s grid of the future. Recent delays in the development of new clean capacity and the ongoing need to invest in older coastal power plants and diesel generation to ensure grid and local reliability make clear that California needs more options to meet state and local climate, air quality, and resilience goals. This is exemplified by the findings of the Joint Agency Reliability Planning Assessment, which highlights the need for up to 10,000 MW of additional capacity by the end of 2025.³ Mainspring is pleased to see support for clean firm power as an essential tool in meeting California’s reliability, resilience, and climate change mitigation needs. As a dispatchable, fuel-flexible, non-combustion power generation technology that meets the workshop presentation’s criteria for a firm zero-carbon resource, linear generators should be explicitly delineated as technology capable of operating on hydrogen (including the ability to generate electricity directly from ammonia, a hydrogen carrier), biogas from gasification or anaerobic digestion, and renewable natural gas (“RNG” or “biomethane”).⁴

First, the fuel-flexibility of Mainspring’s linear generators provides unique benefits to both grid operators and end-use customers – across the resource types listed in the workshop presentation (e.g. hydrogen and RNG). Linear generators are already being deployed to run on readily-available fuels today, such as RNG, and can easily transition to other low- or zero-carbon fuels (e.g., clean hydrogen and ammonia) as soon as they become available. No hardware changes are required for a linear generator to switch fuels, enabling a smooth transition to a zero-carbon retail electric supply. Moreover, by using two moving parts and no lubricants, linear generators represent a functional, reliable resource able to provide both local and system reliability, increasing resiliency.

Second, linear generators use a low-temperature, uniform reaction that maintains peak temperatures below the levels at which NO_x forms (1500°C), resulting in near-zero NO_x emissions at all loads – including during start-up. This is in contrast to the burning of a fuel with a flame, which creates high temperatures and high NO_x emissions. Notably, California’s South Coast Air Quality Management District recently adopted linear generator-specific requirements in the form of Proposed Rule 1110.3, highlighting the low NO_x operation of this technology.⁵ Further, The use of UL-listed inverters for straightforward interconnection enables linear generators to be sited wherever power is needed and permitted in the most stringent air quality regulatory environments. Additionally, linear generators are modular, with the ability to deploy as many units as may be needed to power a given site. This highly flexible technology may therefore serve a large commercial customer’s backup generation need (thereby avoiding diesel-fueled

³ Joint Agency Reliability Planning Assessment SB 846 Quarterly Report and AB 205 Report at 11. February 2023.

⁴ Mainspring’s linear generator also has attributes consistent with multiple categorizations of resources, such as long-duration energy storage, back-up generation, behind-the-meter generation, renewable firming, electric vehicle charging infrastructure, and part of the transmission system infrastructure for congestion relief.

⁵ South Coast Air Quality Management District, “Rule 1110.3 Emissions From Linear Generators”, Adopted November 3, 2023.

backup), represent a facet of a multi-resource microgrid, provide clean resilience to electric vehicle (“EV”) charging stations, or provide a utility-scale front-of-the-meter solution to alleviate congestion constraints and add local resilience. As the grid evolves and load-serving entities undertake an unprecedented effort to procure new generation, linear generators will provide essential flexibility to add to the range of resources needed to meet state climate and air quality targets.

Finally, full dispatchability allows linear generators to consistently match power output with the specific energy need – thus avoiding unnecessary curtailment of renewable resources. Unlimited daily starts and stops means linear generators can provide both clean firm power and zero-carbon backup power whenever it is needed – even during periods of low variable renewable generation (e.g. when the sun is not shining and the wind is not blowing) as well as during multi-day grid events.

Mainspring has already deployed linear generators across a number of locations in California, including units sited at logistics facilities, grocery stores, wastewater treatment plants, and landfills – and continues to expand the number of units in service.⁶ Mainspring applauds the Commission for recognizing the importance of clean firm power to California’s clean energy future, and requests explicit recognition of linear generators to utilize clean fuels –including RNG, hydrogen, ammonia, and biogas– to enable the state to build its grid of the future.

III. Hydrogen and Renewable Natural Gas –Alongside Ammonia and Biogas– are an Essential Means of Providing Clean Firm Power for California’s Future Grid

Mainspring is pleased to see both hydrogen and RNG recognized as clean firm resources in the workshop presentation – both of which are essential building blocks for a clean, reliable grid. As well recognized therein, dispatchable clean firm power is central –alongside the deployment of variable renewable energy generation– in order to meet grid needs. This is rendered even more critical as extreme weather events become more volatile – forcing Californians to endure longer grid outages. Storing renewable energy in the form of hydrogen is a strategic means of ensuring a resilient, reliable energy system while meeting increasingly-stringent state climate goals. As both a hydrogen carrier and –in the case of linear generators– a form of clean fuel itself, clean ammonia should be recognized alongside hydrogen as a resource that can be used to supplement variable renewables across hours, days, weeks, and even seasons to mitigate both periods of low variable renewable generation, as well as more damaging grid stresses.

Alongside hydrogen and ammonia, electricity generated from RNG and biogas can immediately enable clean firm power deployment to immediately decrease the carbon intensity of California’s electricity generation fleet. Wastewater treatment plants, dairies, and landfill facilities often produce much more fuel than can be used onsite (which is often flared when unused), representing a ready source of power that can be used to help meet peak demand on the system – either in biogas or RNG forms. While the production of hydrogen from biogenic feedstocks is a valuable pathway for the creation of hydrogen, biogas itself should be considered more broadly as a tool to generate electricity – especially as increasing the volume of dispatchable generation from clean, renewable resources is critical to maintain reliability, improve air quality, and keep California on track to meet its climate goals. Facilities that are in a position to use excess fuel and turn it into power that can be exported to the grid (rather than flaring the gas) by either generating electricity onsite or injecting fuel into a common carrier pipeline (often described as

⁶ See, for example:

<https://www.powermag.com/pairing-solar-with-linear-generators-yields-a-revolutionary-ci-energy-solution/>
https://napavalleyregister.com/news/local/napa-sanitation-district-going-greener-with-new-power-source/article_681ae698-0fa9-11ee-86cd-afee16747155.html
<https://www.kcra.com/article/how-yolo-county-leaders-transforming-their-landfill/41433005>

“directed” biogas) are an important and immediately available source for clean firm power. When linear generators use renewable fuels generated from organic waste – biogas, biomethane, or hydrogen – they also help to comply with the requirements of SB 1383 (Lara, 2016) to reduce the most damaging climate pollutants known as Short-Lived Climate Pollutants. Utilizing biogas from these sources not only precludes biogas being flared, but directly utilizes it to generate renewable electricity for a range of uses including EV charging, diesel backup generator replacement, and locally-sited distribution deferral.

Hydrogen, ammonia, RNG, and biogas are valuable across a wide range of applications, particularly in light of the workshop presentation’s consideration of multi-day outages. Critical infrastructure such as medical facilities, cold storage facilities, data centers, and others represent commercial and industrial applications where high levels of reliability are of paramount importance. These and similar facilities cannot afford long-duration outages; while a range of resources can provide short-term reliability, hydrogen, ammonia, RNG, and biogas are essential clean firm power tools to enable reliability and clean resilience. This is further reinforced by California’s efforts to electrify both buildings and transportation; during extended grid outages communities and businesses cannot afford to lose access to electric buses, garbage and drayage trucks, and freight movement that provide essential services. As electrification efforts take hold, these communities should not have to endure the status quo of being forced to rely on diesel backup generators that negatively impact air quality when the grid goes down.

Meeting state climate goals, local air quality requirements, and ensuring a resilient, reliable grid all require clean firm power; clean hydrogen, ammonia, RNG, and biogas are well-positioned to enable achievement across all these goals. Particularly in light of the California Air Resources Board’s Advanced Clean Fleets Rule rule, efforts to rapidly deploy fleet zero-emission vehicles at scale requires consideration of on-site clean resilience for use during grid outages; clean fuel-powered distributed generation is a useful tool to enable fleet operators to power fleets to continue serving their communities during extended outages.

IV. Conclusion

Mainspring appreciates the opportunity to comment on this important workshop, and looks forward to collaborating in the future.

Sincerely,

/s/ Serj Berelson

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