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Mainspring Energy Comments on Behind-the-Meter Zero-Emission Backup Technologies (Docket 19-ERDD-01)

Additional submitted attachment is included below.

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October 28, 2022

California Energy Commission
Docket Number 19-ERDD-01
Energy Research and Development Division
1516 Ninth Street
Sacramento, CA 95814-5512

Re: Behind-the-Meter Renewable Backup Power Technologies – Request For Information

To Whom It May Concern:

Mainspring Energy, Inc., ("Mainspring") applauds the California Energy Commission ("Commission") for examining behind-the-meter ("BTM") zero-emissions backup technologies, and we appreciate the opportunity to provide comments.

The Request for Information ("RFI") identifies a multitude of challenges associated with developing and deploying zero-emissions backup technologies. Mainspring offers the following comments and recommendations on the questions posed in the Request for Information of Friday, September 30th, 2022.

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 can be powered using a range of fuels. Mainspring's linear generator offers a unique and highly flexible 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. Full dispatchability and virtually no limits on daily starts/stops also allows linear generators to consistently follow load while also firming renewables, thereby facilitating the continued rapid adoption of renewable energy. Our local linear generators add resilience and real capacity to the grid while also providing enhanced flexibility to help avoid renewable curtailment.[1]

[1] For additional information on technical specifications and performance benefits, visit https://www.mainspringenergy.com/technology/.

Responses to RFI Questions

1. What are key barriers to behind the meter (BTM) zero-emission renewable backup for critical loads? Is the lack of standardized solutions a primary barrier for permitting and interconnection?

Zero-emissions resilient power is essential to simultaneously meeting California's appropriately aggressive climate goals while ensuring a reliable, resilient energy grid. By definition, resilient power requires local power — whether customer-sited or grid-sited. In the wake of recent reliability challenges, California has seen enormous uptake in backup generators, particularly diesel generators, and Mainspring applauds the Commission for recognizing the need to supplant these generators with cleaner alternatives.[2] Mainspring urges the Commission to extend the deployment of zero-emission backup generators for use cases well-beyond "critical loads" (discussion of which is covered in greater detail in our response to question 12). Mainspring recommends that this program be technology agnostic when establishing which resources would be eligible to receive incentives, and instead focus on technology attributes that would contribute most to grid reliability. This approach ensures California does not inadvertently exclude any flexible resources (i.e. both fuel-flexible and operationally flexible) that support reliability. We respectfully urge the Commission to advance technology-inclusive, performance-based standards, in order to encourage innovation and prioritize whichever clean energy solutions simultaneously optimize for emissions reductions and resilience.

A critical barrier to the effective deployment of BTM resources is the use cases under which these resources are deployed. Evaluating BTM generators on multifaceted value, rather than solely their ability to provide backup power, enables sources of clean firm power to represent the most prudent use of state, ratepayer, and even private funds while driving material improvements in both emissions and grid solvency. Mainspring strongly recommends the Commission take criteria beyond backup into account when evaluating any incentives for backup generators, and moreover urges the Commission to incent technologies that simultaneously provide multiple uses including, but not limited to, backup power. These might include primary power, firming of intermittent renewables, peak load reduction, and other use cases that could be categorized under the umbrella of clean firm power.[3] Valuing flexible technologies would further enable BTM zero-carbon generators to participate in wholesale markets (e.g. resource adequacy, demand response), further enhancing their value. Diversifying energy resources to augment intermittent renewables with clean firm power will ensure the grid remains reliable when the sun is not shining and the wind is not blowing, even for days at a time. California has established aggressive targets to combat the climate crisis and clean firm power resources, such as Mainspring's linear generator, which has the flexibility to utilize a variety of zero-carbon fuels, are essential to ensuring that greenhouse gas emissions reductions can be achieved without sacrificing affordability, year-round reliability, and multi-day resilience.

In practical terms, a number of key barriers must be overcome. Above all, simple economics renders existing carbon-intensive backup generators, of which there is an enormous amount deployed in California

[2] Steven Moss and Andy Bilich, M.Cubed, "Diesel Back-Up Generator Population Grows Rapidly in the Bay Area and Southern California" (2020). https://bit.ly/34qOr0b. Backup generators have reached 7,360 MW of capacity in the South Coast AQMD and 4,840 MW of capacity in the Bay Area AQMD based on information for BAAQMD and SCAQMD. The report estimates an average capacity of 0.543 MW for units in SCAQMD and 0.628-0.642 MW for units in BAAQMD.

[3] A useful analysis of clean, firm power can be found in a September 2021 whitepaper published by the Environmental Defense Fund and the Clean Air Task Force, titled "California Needs Clean Firm Power, and so Does the Rest of the World". This has been supplemented by an October 2022 white paper by the same authors "Growing the Grid: A Plan to Accelerate California's Clean Energy Transition., noting that, "Three research teams using five models of California's electricity system all came to the same conclusion: sources of clean firm power… keep the lights on and prices affordable."

currently, far cheaper and easier to permit, own, operate than zero-emission alternatives; this presents another essential barrier that must be overcome with incentives, technical support, and other tools. The deployment of zero-emission backup generators necessitates a supply of zero-carbon fuels; there are a number of ongoing efforts to kickstart production of clean hydrogen and ammonia at the federal, state (including by the Commission), and regional level that are prerequisites for the success of this program. Further, lack of familiarity with codes such as the National Fire Protection Association codes (e.g. Section 5.1 of the NFPA code on "Emergency Power Supply: Energy Sources, Converters, and Accessories") can subject deployment of zero-emission backup generators to perceived feasibility hurdles that are not faced by existing diesel and gasoline backup generators.

Finally, terminology can create a barrier of uncertainty. This RFI, for example, uses “zero-emission” and “renewable” interchangeably. However, in practice, each of these terms has different definitions. Fuels such as renewable natural gas, biogas, and others may be considered “renewable” without being “zero-carbon” (and in some cases, biofuels can even be “carbon negative”). Meanwhile, hydrogen and ammonia are inherently zero-carbon fuels (there are no carbon molecules in the fuel) and *can* be zero-emissions fuels when produced using renewable energy sources, though the definition of what defines such fuels as zero-emissions is itself subject to no small debate. On the other hand, “critical loads” is a term that should be broadly defined to include a host of facilities essential to society; such facilities are described in Mainspring’s response to question 12. Mainspring supports a “yes, and” approach that maximizes the use of zero-carbon and renewable fuels to ensure California is able to effectively meet both its climate and resilience goals.

2. What are the current opportunities for standardizing design of how BTM backup systems interconnect with the distribution grid while enhancing safety and managing operational constraints?

First, a key opportunity for standardization of design would be to have a set of approved relays or controllers for purpose that are applicable across jurisdictions and mitigates the need for utilities double checking working designs. Enabling this standardization will reduce costs and facilitate rapid deployment of BTM zero-emission backup technologies.

Second, the Commission should develop a standard that clearly defines when backup battery power should require fixed substation battery racks versus the much more cost-effective and simple integrated-battery uninterruptible power supply systems. For BTM backup applications, uninterruptible power supplies are often adequate but the timelines to get them approved as a variance to the rules is challenging for developers and utilities.

3. If the CEC issues a solicitation in this research space, should there be carve outs for specific technologies or technology bundles targeting specific performance metrics (e.g., separate groups each targeting a technology such as critical load panels, switchgears, and multi-mode inverters)? How should technologies be bundled, and what metrics should be targeted?

Yes, Mainspring recommends carve outs for certain technologies and attributes, as described in our response to Question 1. In particular, the Commission should create carve-outs that incentivize desirable characteristics that BTM backup systems bring to the table, including non-combustion and fuel-flexible technologies (i.e., those that can switch between fuels without hardware changes). In addition, the Commission should create discrete carve outs for technologies capable of rapid response to system market signals, including those that are rampable/dispatchable. Moreover the carve outs should not be mutually

exclusive, but rather stackable; if a single technology engenders more than one desirable attribute and is therefore eligible for more than one carveout, that resource represents a higher value to both local communities and the grid. Eligibility for one carve-out should not preclude access to other carve-outs, and technologies should be able to access multiple carve-outs simultaneously to realize the full value they provide to the grid. In creating carve-outs, Mainspring recommends the Commission develop a framework that captures the stackable, multi-faceted value that technologies offer. For example, should the Commission create carve outs for both fuel flexibility and the ability to provide primary power in addition to backup power, a technology that represents both of these attributes should obtain a higher value. Valuing technologies that provide multiple values will enable the Commission to maximize the investment in BTM zero-emissions technologies.

4. If the solicitation included multiple groups, how should those groups be structured? Some examples below:

a. Multiple-group solicitation:
i. One group for Applied Research and Development (ARD) projects that would pilot emerging technology in a controlled environment and engage with stakeholders, including CBOs and municipalities.
ii. Another group for Technology Deployment and Demonstration (TDD) projects that would roll-out and implement technology mature enough to seek rapid-deployment for near-term benefits.

The Commission should explicitly incentivize projects for multiple groups. These solicitation groups should, at the very least, include groups focused on generation technologies such as those that are technologically mature, utilize zero-carbon fuels, capable of operating on multiple different fuels (e.g. hydrogen and ammonia), and/or the ability to be sited at remote locations, etc. As described in our response to question 3, technologies that are eligible for more than one solicitation group should not be precluded from applying for project-specific incentives across multiple solicitation groups.

10. What are some examples of emerging technology solutions not previously mentioned in this RFI that could streamline interconnection and permitting for BTM solar-paired energy storage or other zero-emission backup power? To what extent have these technologies been validated in the field?

Linear generators have not been previously mentioned, and provide a range of benefits, as described above and as previously recognized by the Commission.[4] As a modular and scalable technology, Mainspring's linear generators can be deployed in load pockets as both backup power and as a flexible capacity expansion solution with the ability to immediately run on a range of renewable fuels including both 100% ammonia and 100% hydrogen.[5] This means that linear generators should be considered as a behind-the-meter backup generator solution. Linear generators are a clean firm resource that can increase

[4] Energize Innovation Powered by California Energy Commission, "High-Efficiency and Ultra-Low Emissions Linear Generator Demonstration Project in Southern California". Available at: https://www.energizeinnovation.fund/projects/high-efficiency-and-ultra-low-emissions-linear-generator-demonstration-project-southern

[5] Emma Penrod, Utility Dive, "Tests show fuel-flexible linear generators can use both hydrogen and ammonia". June 22, 2022. Available at: https://www.prnewswire.com/news-releases/in-breakthrough-for-clean-power-generation-mainspring-announces-worlds-first-generator-to-run-both-hydrogen-and-ammonia-fuels-301572750.html

reliability in grid-constrained locations by providing backup power as well as providing primary power, complementing existing and forthcoming deployment of renewable energy through firming intermittent generation, and providing demand response and peak load reduction. Mainspring's products are UL listed and have been operating at numerous sites throughout California, including by providing both primary and backup power, to grocery stores, cold storage facilities, landfills, and food distribution centers, as well as as part of multi-resource microgrids.

12. What applications or use cases might be the best fit or highest priority for achieving easily replicable solutions with maximum impact? For example:

a. Multifamily housing and community centers.
b. Emergency facilities in wildfire-prone areas.
c. Manufactured homes.
d. Critical loads in common areas affected by Public Safety Power Shutoffs.
e. Homes in under-resourced communities with outages higher than the utility average and/or that are subject to extreme heat conditions.

The applications that should represent the highest priority include important facilities (not just "emergency", e.g. cooling centers) in wildfire prone areas, critical loads in areas commonly affected by Public Safety Power Shutoffs, critical facilities such as data centers,[6] communication centers, electric vehicle charging stations, upstream facilities (e.g. food distribution and ports), as well as community microgrids. Each of these applications needs to continue operation in the face of grid outages, and in many cases have already installed diesel backup generators to enable continued operation. Moreover, the Commission should ensure backup generations located in under-resourced communities are the focus of this initiative, as the diesel generators currently used for most backup applications have a disproportionate effect on the air quality in these already-beleaguered communities (see Mainspring's response to question 15 for greater detail).

13. What are the most significant barriers (technical, cost, design, permitting, etc.) to integrating BTM backup power in the various sectors (e.g., residential, rural) and use cases mentioned above? What unknowns can be illuminated through research? Please be as specific and concise as possible in your response.

Cost remains the most significant barrier to displacing incumbent diesel and gasoline BTM backup generators, particularly in the commercial and industrial space. Commercial & industrial business owners and energy managers have decades of experience of being able to cheaply purchase and operate diesel gensets, breeding a familiarity among owners, operators, and permitters that can be difficult to overcome. This cost issue is rendered significantly more dire given the significant expansion of diesel backup generators in response to California's ongoing reliability issues; the number of diesel backup generators in 2021 the Bay Area and South Coast Air Quality Management Districts alone was over 12 GW, equivalent to 15% of California's *total grid capacity*.[7] Since many diesel backup generators are sited in low-income and disadvantaged areas, these communities face a disproportionately higher threat to public health. Recent analysis indicates that diesel-related pollution may trigger upwards of $136 million of health costs per year,

[6] The Federal Communications Commission (FCC) requires cellular phone and internet providers to maintain "…at least one option that provides a minimum of twenty-four hours of standby backup power.", per FCC Record 33 FCC Rcd 11641 (18).

[7] Steven Moss and Andy Bilich, M.Cubed, "Diesel Back-Up Generator Population Grows Rapidly in the Bay Area and Southern California", p. 2. 2020. Available at: https://bit.ly/34qOr0b

due to increased mortality, heart attacks, hospital visits and other adverse consequences.[8] It is imperative that the Commission develop and deploy incentives that rapidly accelerate the ability of zero-carbon BTM generators to displace diesel and gasoline generators in order to meet both the state's emissions and reliability goals.

Permitting is another central barrier to integrating BTM power in the various sectors referenced above. Permitting remains a key source of delays for BTM backup power, particularly regarding Air Quality Management Districts, buildings departments, fire districts/departments, and utilities. In particular, as production and availability of zero-carbon fuels increases, existing technologies capable of utilizing these fuels will face localized hurdles in deploying rapidly and at-scale, especially as compared with existing backup technologies like diesel generators. It is essential that the Commission lays out clear guidelines, which should consider factors such as improved air quality, footprint, and noise pollution. Such guidelines could potentially even include a "playbook" or "user guide" for permitting of new BTM zero-emission backup technologies to ensure consistency across geographic areas, utility service territories, and municipalities to facilitate rapid uptake.

However, while Mainspring agrees that additional research and analysis of key questions is beneficial for the deployment of BTM zero-emission backup technologies, there are real world examples of power generators using advanced fuels that are on the ground now, such as linear generators, or will be in the near future. The Commission should leverage the experience gained by existing generation projects using zero-carbon fuels such as hydrogen and ammonia to inform future advanced fuel policies in addition to investing in further research and development.

15. What are the most significant barriers to integrating BTM zero-emission backup power in under-resourced communities (low-income, disadvantaged, tribal)? What technology solutions or research areas could overcome these barriers?

Key barriers to integrating BTM zero-emission backup power in under-resourced communities continues to be the dearth of investment focused on addressing the needs of low-income, disadvantaged, and tribal communities. These communities suffer from a plethora of historic and systemic inequities, which has caused a level of distrust for government and authoritative bodies. Resources including, but not limited to, technical support, grant application writing, favorable financing terms, ownership, community engagement and involving the community in decision-making, and community-benefit agreements allow communities to embrace changes in their environment.

From a technology feature and characteristic standpoint, products that occupy a smaller footprint in the community landscape, represent low levels of operations and maintenance, be easy-to-use, and improve health outcomes with reduced noise, CO2 and NOx output compared to existing backup generators should be prioritized. Specifically, air quality must be a critical concern for replacing diesel with zero-emission backup power – particularly in the near-term. The total amount of existing and proposed diesel backup generator capacity in the broader San Francisco Bay Area region for just one "critical load" type is equivalent to the generating capacity of the Diablo Canyon nuclear power plant.[9] As described in Mainspring's response to question 12, the Commission should focus on deploying zero-emission BTM

[8] *Ibid.*

[9] Jason Fordney, California Energy Markets, "Diesel Generators Proliferate in California, Often as Backup for Data Centers". July 9, 2021. Available at: https://www.newsdata.com/california_energy_markets/bottom_lines/diesel-generators-proliferate-in-california-often-as-backup-for-data-centers/article_df3baed0-e100-11eb-89df-47ee56eece30.html

backup generators in communities that have been disproportionately impacted by pollution and other negative environmental impacts.

As mentioned previously in Mainspring's comments, it is essential that the Commission invest in BTM backup technologies that are able to provide multiple uses –including, but not limited to, backup power– in under-resourced communities, to maximize the value of any state investment. These communities, which are disproportionately impacted not only by environmental factors such as pollution, but also Public Safety Power Safety (PSPS), deserve solutions that provide emissions reductions, resilience, and local empowerment not just during outages, but throughout the year.

Conclusion

Mainspring appreciates the opportunity to comment on the RFI and looks forward to collaborating in the future.

Sincerely,

/s/ Serj Berelson

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