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Project Title:	Research Idea Exchange
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Document Title:	Behind-the-Meter Zero-Emission Backup Technologies
Description:	The California Energy Commission is gathering information for a potential future solicitation focused on research needed to develop emerging solutions to enable plug-and-play, zero-emission resiliency at reduced costs through standardized design. Stakeholders are not required to respond to every question of this RFI. In fact, stakeholders are encouraged to respond specifically to the questions they feel most suit their knowledge and background.
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Request for Information: Behind-the-Meter Zero-Emission Backup Technologies

Please visit: https://www.energy.ca.gov/funding-opportunities/feedback-opportunities/behind-meter-zero-emission-backup-technologies to view online and submit your comments.

The California Energy Commission is gathering information for a potential future solicitation focused on research needed to develop emerging solutions to enable plug-and-play, zero-emission resiliency at reduced costs through standardized design. Stakeholders are not required to respond to every question of this RFI. In fact, stakeholders are encouraged to respond specifically to the questions they feel most suit their knowledge and background.

Behind-the-meter zero-emission renewable backup power is feasible, but effective and safe integration requires additional costly equipment such as battery storage, battery inverters, and transfer switches. Resilient systems require expensive customization in comparison to lower-cost, drop-in backup power generators that use diesel or gasoline as their fuel source. These fossil fuel-powered generators, emitting large amounts of criteria pollutants and greenhouse gases that contribute to climate change, are deployed during outages from extreme heat, nearby wildfire, and Public Safety Power Shutoff (PSPS) events that are exacerbated by climate change. Breaking this unsustainable feedback loop requires transitioning to zero-emission backup power, which has affordability challenges that can be especially difficult for low-income and under-resourced communities.

The EPIC 4 Investment Plan identifies this research need under Initiative 15 “Behind-the-Meter Renewable Backup Power Technologies,” which focuses on developing modular electrical equipment that can safely enable behind-the-meter, zero-emission, renewable generation systems to provide backup power functionalities with streamlined installation at reduced cost. These functionalities may include the ability to island and form a microgrid, but the primary goal of this research initiative is to power critical loads in a grid outage. The CEC would appreciate your responses to the following questions to help define critical research needs in this area and identify high-impact use cases that a future research solicitation may target.

The following are general questions that will help structure solicitations related to this topic:

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?
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?

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?
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.
    b. Multiple-group solicitation in which each group is defined by a particular site characteristic or use case. Examples could include: urban and rural, residential and commercial, various climate zones.

The following will help target specific technology advancement research:

5. EPIC 4 Initiative 15 mentions specific potential research areas for BTM backup technologies, listed below. What is the current state of the each technology, and what research and design considerations are required to advance the technology and market readiness of each?
    a. Customary electrical equipment, such as critical load panels and meters, that are integrated with multi-mode inverters with enhanced islanding functions.
    b. Standardized switchgears and/or integrated power centers that can be rapidly deployed at several locations with minimal alterations.
    c. Multi-mode or hybrid inverters with built-in battery storage backup system capabilities.
6. What is the current Technology Readiness Level (TRL), or state of technology, for meter collars (i.e., electrical equipment that plug-in directly between a meter and its meter socket) that streamline the integration of solar PV, battery energy storage, electric vehicle charging, and other DERs?
    a. What research is needed to advance the TRL of this technology towards commercialization?

    b. How broad is the market – are multiple technology vendors developing this technology?
    c. What design considerations and advanced functionality may be useful enhancements to this technology going forward?
    d. What would be the highest-impact demonstration use cases for which advanced meter collar functionality could be validated in the field?

7. Would integrating multi-mode inverters and islanding functions into critical load panels increase system reliability and ease installation while reducing overall system costs and complexity? What design considerations, technology development, and performance metrics are necessary to achieve this?
8. What would be the most strategic form of implementation for the next generation of critical/smart load panels?
    a. Specifically designed to power essential loads and/or small devices during a grid outage?
    b. Built-in switchgear to facilitate islanding of a mini-microgrid?
    c. Facilitate ease of retrofitting existing, older buildings that have outdated/legacy electrical panels?
    d. Other potential areas not covered above?
9. What is the current state of technology for portable battery storage systems that can serve as a direct replacement for portable diesel generators?
    a. What design considerations or modifications are necessary to allow the portable battery storage system to charge directly from the rooftop solar PV during a local grid outage with plug-and-play functionality?
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?
11. What BTM renewable backup power technology is mature enough to move forward from pilot-scale (ARD) to technology demonstration-scale (TDD)?

The following will help identify high-impact use cases for this research to target:

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.

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.
14. What factors need to be considered when deploying BTM generation at different climate zones and environments? How might technology solutions vary depending on the climate zones in which they are sited? What research is needed for modular, standardized BTM generation equipment to address the unique needs of California's various climate zones?
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?
16. How can BTM generation (with optionally paired storage and additional DERs) be designed and streamlined to be more effectively deployed at multitenant rental properties?
    a. What ownership structure mechanisms would need to be put in place and how would this ensure that tenants receive benefits?
    b. Please list any examples of real-world implementations, including both good examples worth replicating and cautionary tales worth learning from.