CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

ENERGY RESEARCH AND DEVELOPMENT DIVISION

FINAL PROJECT REPORT

Enabling California's Resilient Tribal Communities with Mobile Renewable Power

March 2025| CEC-500-2025-010

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ACKNOWLEDGEMENTS

The authors acknowledge the Electric Program Investment Charge Program and the California Energy Commission for the sponsorship of the project, as well as the communities of the Soboba Band of Luiseño Indians, the La Jolla Band of Luiseño Indians, and Blue Lake Rancheria.

PREFACE

The California Energy Commission's (CEC) Energy Research and Development Division supports energy research and development programs to spur innovation in energy efficiency, renewable energy and advanced clean generation, energy-related environmental protection, energy transmission, and distribution and transportation.

In 2012, the Electric Program Investment Charge (EPIC) was established by the California Public Utilities Commission to fund public investments in research to create and advance new energy solutions, foster regional innovation, and bring ideas from the lab to the marketplace. The EPIC Program is funded by California utility customers under the auspices of the California Public Utilities Commission. The CEC and the state's three largest investor-owned utilities—Pacific Gas and Electric Company, San Diego Gas and Electric Company, and Southern California Edison Company—were selected to administer the EPIC funds and advance novel technologies, tools, and strategies that provide benefits to their electric ratepayers.

The CEC is committed to ensuring public participation in its research and development programs that promote greater reliability, lower costs, and increase safety for the California electric ratepayer and include:

- Providing societal benefits.
- Reducing greenhouse gas emission in the electricity sector at the lowest possible cost.
- Supporting California's loading order to meet energy needs first with energy efficiency and demand response, next with renewable energy (distributed generation and utility scale), and finally with clean, conventional electricity supply.
- Supporting low-emission vehicles and transportation.
- Providing economic development.
- Using ratepayer funds efficiently.

For more information about the Energy Research and Development Division, please visit the CEC's research website (www.energy.ca.gov/research/) or contact the Energy Research and Development Division at ERDD@energy.ca.gov.

ABSTRACT

California's Tribal communities are highly impacted by planned and unplanned public safety power shutoffs and grid outages. Entire communities are often left without power, and many critical facilities are left inoperable or dependent on expensive, noisy, polluting fossil fuel powered generators. Outages can greatly limit the ability to provide critical services and timely responses to an emergency or disaster. Tribal communities are often very rural, which leads to longer distances traveled to reach critical services and they rarely have the ability to quickly mobilize electric power to where it's needed most. To address this issue, GRID Alternatives, ONYX Power, and the University of California, Riverside successfully deployed 30 grid-independent, rapidly deployable, modular and expandable generation systems to enable three California Tribal communities to provide critical electric services when the grid is down. Additionally, the reliable, highly mobile off-grid resources can support facilities and services throughout the year. This mobile critical resilience model provided the functionality to study multiple use cases and advance mobile generation technology throughout California, as well as provide immediate, flexible and scalable relief to communities suffering the most from the effects of wildfires and grid outages.

Keywords: mobile generation, resilience, deployable renewable energy, critical backup power

Please use the following citation for this report:

Dumovich, Daniel B. (GRID Alternatives), Miroslav Penchev, and Alfredo A. Martinez-Morales (University of California, Riverside). 2025. *Enabling California's Resilient Tribal Communities with Mobile Renewable Power*. California Energy Commission. Publication Number: CEC-500-2025-010

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Background

California's Tribal communities are highly impacted by planned and unplanned public safety power shutoffs and grid outages. Entire communities are often left without power, and many critical facilities are left inoperable or dependent on expensive, noisy, polluting fossil fuel powered generators. Outages can greatly limit the ability to provide critical services and timely responses to an emergency or disaster. Tribal communities are often very rural, which leads to longer distances traveled to reach necessary services and makes it difficult to quickly mobilize electric power to where it's needed most. The Soboba Band of Luiseño Indians, one of the host communities for this project, experiences over four times the outages of a typical Southern California Edison utility customer (SCE, 2024).

For this project, GRID Alternatives, ONYX Power, and the University of California, Riverside proposed to deploy grid-independent, rapidly deployable, modular and expandable generation systems to enable California's Tribal and under-resourced communities to provide critical electric services when the grid is down. The reliable, highly mobile off-grid resources can also support facilities and services throughout the year. This mobile critical resilience model would not only provide the functionality to study multiple use cases and advance mobile generation technology throughout California, but it would also provide immediate, flexible, and scalable relief to families and communities that are suffering the most from the effects of wildfires and grid outages.

Project Purpose and Approach

This project used a hands-on, community-centric technology deployment approach, utilizing community engagement and feedback to solve critical reliability issues in California's Tribal communities while demonstrating multiple use cases for grid outages, emergencies, and year-round off-grid applications. The deployment approach was to ensure that units were made available as quickly as possible to all three communities while allowing for flexible distribution between individuals, general community uses through dedicated facilities, and emergency deployment readiness. Instead of assigning specific units to specific tasks, all units within the community were able to be transferred and mobilized to provide the greatest impact and adjust for additional uses discovered throughout the project term. The overall purpose was to provide replicable and scalable solutions to fill the gap between small fossil fuel powered generators and grid-tied battery systems. It is not equitable for disadvantaged communities, already suffering from disproportionately poor air quality and resource inadequacy, to rely upon polluting generators for backup power. Fossil fuel powered generators further exacerbate proximal air quality with life-threatening carbon monoxide and nitrous oxide emissions, especially during the highly vulnerable time of a power outage. This project utilized ONYX Rhino Mobile Renewable Backup Generators (MORBUGS) to demonstrate a cleaner, mobile solution to provide backup power. The Rhino's innovative approach to both the technology solution and the deployment strategy demonstrated the ability to address multiple barriers at

once, while continuously incorporating community feedback and maximizing participation and buy-in.

Project Goals and Objectives

The goals of this project were to:

- Increase resiliency for California's Tribal communities by providing backup power to critical facilities and residents during grid outages and emergencies.
- Strengthen Tribe emergency plans and resources by providing the community with a centralized location with electricity to convene during an emergency.
- Study and test the best use cases and application of mobile generators with each community, including:
    - Mobile electric power services and uses in off-grid applications.
    - Deployment at key facilities, community centers, and other daily non-emergency applications.
    - Individual home backup using a transfer switch.
- Significantly and permanently reduce greenhouse gasses and criteria air pollutants attributed to the use of fossil fuel powered generators.
- Provide cost savings by reducing travel, gas consumption, and other costs associated with residents searching for electric power during an outage or emergency.
- Provide Tribal communities with hands-on job training and access to the growing clean energy economy through the development and deployment of the product.
- Contribute to the growing body of research on mobile renewable generation in California.

The key objectives were to:

- Demonstrate that the ONYX Rhino can provide whole-house (or most-of-house) critical backup power for residents during grid outages and emergencies when used with a transfer switch or similar equipment.
- Demonstrate the ability to provide multi-day clean power via the use of ONYX Rhinos and deployable and foldable solar mats.
- Demonstrate the "Clean Power Community Resource" model, which can be implemented if a community chooses, where ONYX Rhinos can be centrally stored and then deployed to residents or locations that need mobile clean power sources.
- Demonstrate the use of the ONYX Rhino as a drop-in replacement for mobile fossil fuel powered generators for non-emergency services.
- Gather feedback from community users on what works and what opportunities exist, both in terms of the product and the deployment approach.

Project partner University of California, Riverside provided comprehensive measurement and evaluation that tracked the metrics included in the goals and objectives of this project, as well as additional metrics that would further the project's goals. Project partner ONYX Power brought the experience of working on multiple applications of its technology and worked with GRID Alternatives to ensure that the systems were tracking key performance metrics, such as outage size and duration, proper application within each community, previously defined and newly discovered use cases, and other scalability metrics used for future knowledge transfer and technology advancement activities.

Key Results

A total of 32 Rhino MORBUG systems were built with funding from the California Energy Commission and match funding from project partners. Ten Rhino units were deployed to each of three Tribes: Blue Lake Rancheria, the Soboba Band of Luiseño Indians, and the La Jolla Band of Luiseño Indians. Two additional units were available for demonstrations and were used for product testing. Compatible, rapidly deployable solar units (Merlin Panther and ONYX Manta) were sourced and deployed to the Tribes to pair with the ONYX Rhinos in quantities according to specific community requests and anticipated utilization. Each Tribe also received one spare inverter, a battery, and a charger for low voltage battery recovery. The results of the deployment are summarized as follows:

- **Rapid Production:** Creative arrangements were made between project partners to ensure rapid production of the systems for early-stage system deployment.
- **Delivery:** All 30 systems were successfully delivered to three Tribal communities ahead of the anticipated schedule.
- **Use Case Analysis:** Multiple use cases were studied for both emergency and daily uses. The duration, power output and loads, and the weather conditions were tracked by Tribes during use cases, providing valuable insights into the functionality and applicability of the technology.
- **Community Feedback:** The Tribal community members provided critical feedback on the use of, value of, and training needed for the technology.
- **Adjustments and Service:** Significant improvements were made to the technology after use case and community feedback analysis was completed, including service trips and improvements to the training and operations related to the technology.

In addition, the "15-minute rule" — that the Rhinos were able to be set up and operational in 15 minutes or less — was achieved.

Knowledge Transfer and Next Steps

The primary knowledge transfer objectives that drive the technology advancement initiatives of the ONYX Rhino technology were successfully achieved. The objectives included: direct engagement with communities and emergency services providers; presenting the technology in public, real world settings to demonstrate off-grid capabilities; and publication of articles

about and media attention around the overall use of the Rhino systems in both emergencies and normal community events.

By demonstrating the multiple applications of the ONYX Rhino, this project gathered valuable insights from community members that informed further product improvements. These improvements included: a 31-percent reduction in the size of the next-generation Rhino (from 45 x 26 x 17 inches to 32 x 25 x 17 inches); a 32-percent reduction in weight (from 325 pounds to 220 pounds); implementation of a more intuitive on-off sequence; inclusion of an automatic air conditioning shutoff feature to minimize full energy runout that requires system recharge by a special procedure; creation of a 4G remote monitoring system for tracking fleet operations; development of the ONYX M5 Manta mobile solar system based on Tribal community feedback on the Merlin Panther solar systems; and the planned development of the X5 and X10 battery expansion packs for plug-and-play extended energy. Ongoing media engagement, publications, and policy development activities will be critical next steps to advancing this technology and community-centric model of deployment.

CHAPTER 1: Introduction

Conventional small fossil fuel powered generators are loud, create harmful emissions, and create a fire risk due to flammable fuel and hot exhaust surfaces during operations. Despite these issues, they are ubiquitous because they are widely commercially available, are deployable in real time, and can be connected to individual off-grid loads or a home using a transfer switch for backup power. Grid-tied home batteries solve the issues of sound and exhaust but require a long procurement and permitting cycle. This means they cannot be deployed flexibly and rapidly; they are not expandable in energy once installed, and they cannot be replaced or easily relocated. The Rhino Mobile Renewable Backup Generator (MORBUG) system includes technology advancements that address the shortcomings of both fossil fueled generators as well as grid-tied home batteries: it is quiet, it is emissions-free, it can be rapidly deployed in real time, it can expand in energy capacity, it requires limited lead time and no permitting, it can power a home through a transfer switch like a generator, and the batteries and inverter can be replaced or upgraded in the future.

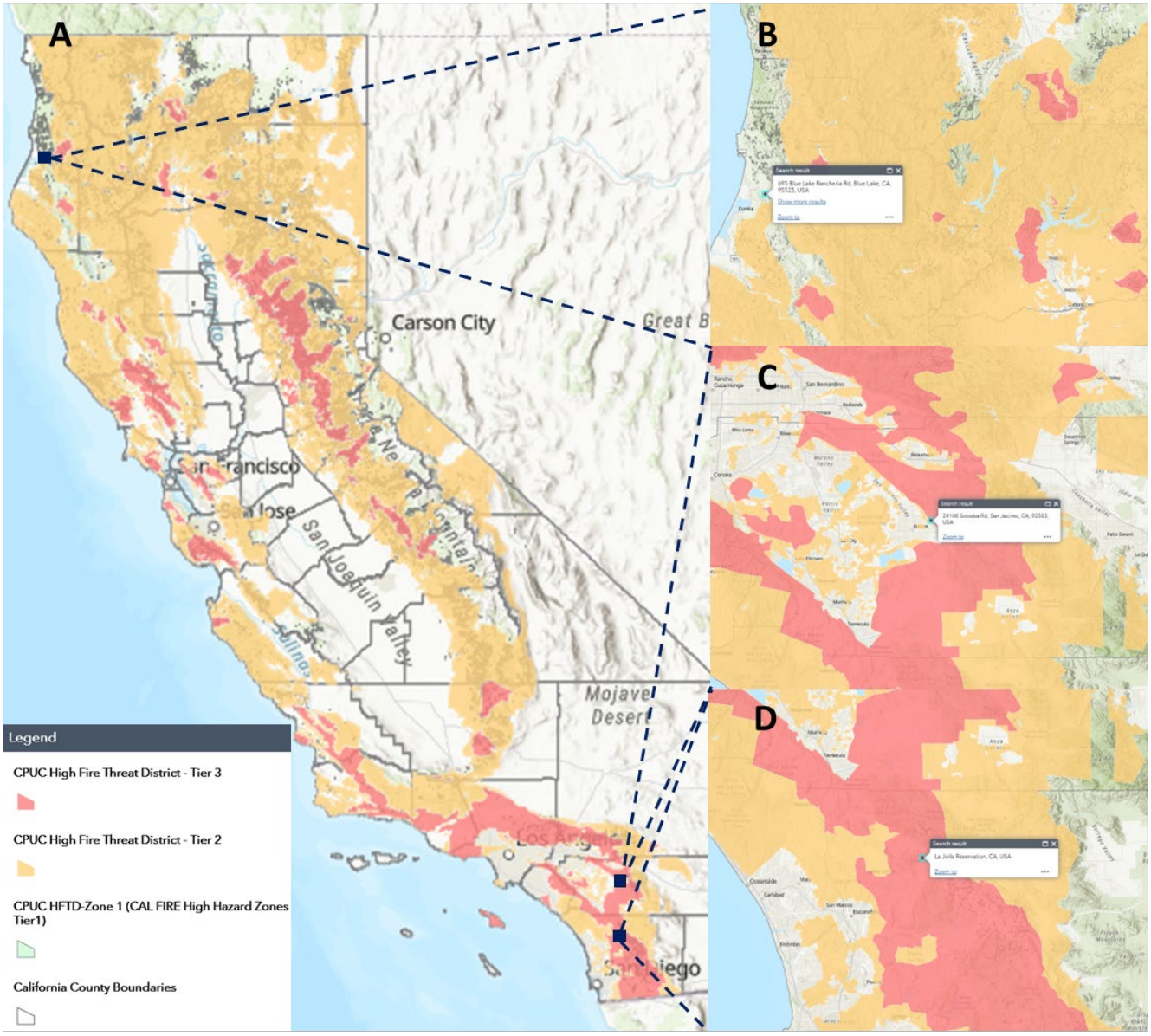
The addition of highly portable, easy-to-connect, lightweight solar PV modules allows for additional renewable generation at any location and at a large enough capacity to recharge the Rhino battery system within a single day, allowing for continuous operation over multi-day outages and emergencies. The Rhino can also provide 120 volts (V) and 240V power while simultaneously charging from a renewable energy resource, so there will be no service or energy interruption throughout an extended outage. In addition, all system components and modules can be moved throughout the community, to suit the evolving needs of residents, critical infrastructure, and facilities. The fully self-contained, modular, expandable, compact, and durable design of the Rhino MORBUG system creates a wide range of options for a household or community to utilize during an outage or emergency.

CHAPTER 2:
Deploying Mobile Renewable Generation in California Tribal Communities

Tribal communities often face multiple barriers to accessing renewable technologies, resilience measures, workforce opportunities, and resources during outages or emergencies. Figure 1 shows that the Tribal communities supported by this project are either in or adjacent to a high fire threat district. This project and the Rhino's innovative approach to both the technology solution and the deployment strategy have addressed multiple barriers at once, while continuously incorporating community feedback and maximizing participation. New solutions are needed that are available and equitable to the communities that are most in need and that can compete with conventional fossil fuel powered options.

Grant funding from the California Energy Commission (CEC) enabled the rapid production of 30 systems, field testing, gathering of community feedback, and analysis of use cases. Ten Rhino units were deployed to each of three Tribes, as outlined in Table 1. Two additional units were made available for demonstration by the CEC and were used for product testing. Compatible, rapidly deployable solar units (Merlin Panther and ONYX Manta) were sourced and deployed to the Tribes to pair with the ONYX Rhinos in quantities according to specific community request and anticipated utilization. Each Tribe also received one spare inverter and a battery as well as a charger for low voltage battery recovery.

Figure 1: Mobile Renewable Backup Generation Map



(A) California Public Utilities fire threat district map with demonstration site locations indicated. (B) Blue Lake Rancheria Tribe. (C) Soboba Band of Luiseño Indians Tribe. (D) La Jolla Band of Luiseño Indians Tribe.

Source: California Public Utilities Commission

Table 1: Deployment Sites Information

Tribe	Soboba Band of Luiseño Indians	La Jolla Band of Luiseño Indians	Blue Lake Rancheria
Primary Leadership	Kenneth McLaughlin, Public Works; Mikayla Mendoza, Public Safety	Carla Rodriguez, Director of Public Works	Jana Ganion, Sustainability and Government Affairs Director

Tribe	Soboba Band of Luiseño Indians	La Jolla Band of Luiseño Indians	Blue Lake Rancheria
Location	24099 Soboba Rd, San Jacinto, CA 92583	22000 Hwy 76, Pauma Valley, CA 92061	777 Casino Way, Blue Lake, CA 95525
Climate Zone	10	14	1
Census Tract	6065941500	6073019101	6023010300
CalEnviroScreen (4.0) Percentile (%)	34	47	32
Pollution Burden Percentile (%)	9	49	21
Fire Threat Zone/Public Safety Power Shutoffs (PSPS)	Tier 3: Extreme High	Tier 3: Extreme High and PSPS	PSPS
Regional GRID Alternatives Office	GRID Alternatives Inland Empire (IE)	GRID Alternatives San Diego (SD)	GRID Alternatives North Coast/Bay Area (BANC)
Investor Owned (Electric) Utility (IOU)	Southern California Edison (SCE)	San Diego Gas & Electric (SDG&E)	Pacific Gas and Electric (PG&E)

Source: GRID Alternatives

ONYX Rhino Technology

The ONYX Rhinos are mobile, modular, zero-emissions battery-based energy storage and power delivery units that provide a replacement for fossil fuel generators. The Rhinos are capable of outputting dual 120 volt alternating current (VAC) and 240 VAC at up to 4 kilowatts (kW) continuous and have a 6-kilowatt-hour (kWh) energy storage capacity onboard. The Rhinos can recharge off-grid from solar photovoltaic (PV) up to 2 kW, on-grid at 120 VAC, or both simultaneously. Rhinos can also be connected to each other via a dedicated parallel port for increased storage capacity. These units were intentionally designed to be manufactured and serviced with basic training and without the need for specialized tooling.

Production and Delivery Process for ONYX Rhino Units

The relatively rapid production of the ONYX Rhino units was assisted with purchase agreement terms that supported cash flow by giving significant priority to the procurement of components required to manufacture the systems. This front-loading of ONYX Power's (ONYX) invoices also avoided supply chain concerns and allowed the manufacturing to be completed ahead of schedule. ONYX's modular manufacturing lends itself to enabling potential system builds by local community recipients in the future.

Ten Rhino units were delivered to each Tribe in Fall 2022 in accordance with the planned schedule. Manufacturing and end-of-line testing of all 32 ONYX Rhino units were completed prior to shipment and delivery of all units to the Tribes. Shipments delivered in Tribal territory

were treated as sales tax exempt with the honored tax exemption certificate for each Tribe received by the project team and maintained for records. ONYX used employee vehicles to deliver directly to Southern California locations of the La Jolla Band of Luiseño Indians and the Soboba Band of Luiseño Indians; delivery to Blue Lake Rancheria involved a third-party palletized shipment with acknowledgement of hazardous materials handling for LiFePO4 battery technology. Photos of delivery of the systems can be seen in Figure 2 and Figure 3.

Figure 2: First Delivery of Units, La Jolla

Source: GRID Alternatives

Figure 3: Shipping and Handling

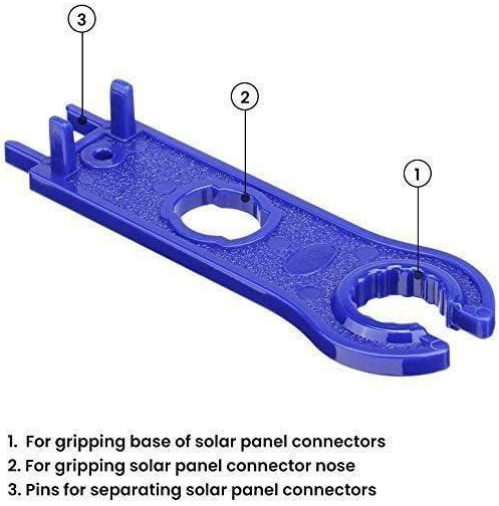
Left: Lift assist on truck. Right: Pallets of ONYX Rhinos packed for shipping to Blue Lake Rancheria.

Source: GRID Alternatives

Solar Units

The project team sourced and procured deployable solar units compatible with charging the Rhino systems. A vendor relationship was established with Merlin Solar Technologies for rugged, military grade, flexible, durable, and quickly deployable solar mats with 1 kW output; these are sufficient to recharge a Rhino with one or up to two full mats connected in parallel. The project team negotiated the build of Merlin Solar's deployable Panther 1-kW solar blanket units for direct shipment to Tribes with the same tax exemption mentioned above. An unanticipated design issue with Merlin Panther blanket connections was addressed with the procurement of additional connectors and installation schematics to ensure full charging capacity of all eight elements on the blanket in series. Extension connectors were assembled and delivered to Tribes for solar recharge of the Rhino units, along with solar connector spanner wrenches (shown in Figure 4) to assist in any disconnecting of the MC4 (Multi-Contact, 4 millimeter) fittings.

Figure 4: Solar Units



Left: Merlin Solar Panther connected to Rhino. Right: Solar spanner wrench for MC4 connectors.

Source: GRID Alternatives

In parallel, ONYX developed and manufactured a new solar product, the Manta, which is an accordion-style unit inside a hard case (Figure 5). At 0.5 kW each, these are approximately half the power and half the weight of the Merlin Panther units; two of these units were deployed to the Soboba Band of Luiseño Indians. Use experience by the La Jolla Band of Luiseño Indians demonstrated the value for a smaller, more easily transportable and deployable unit by a single person, particularly for community events. Two additional updated ONXY M5 Manta mobile solar system (M5) units were manufactured for delivery to the La Jolla Band of Luiseño Indians in November 2023. The outlay of supplied solar equipment for the entire project is summarized in Table 2.

Figure 5: ONYX Manta Solar Unit

Left: Manta folded in front of Rhino. Right: Manta accordion open.

Source: GRID Alternatives

Table 2: Solar Equipment Supplied

Tribe	Solar Merlin Panther (1000W)	Solar ONXY Manta/M5 (500W)	Notes
Soboba	9	2	Preference for full capacity. Flexible to try multiple design options.
La Jolla	6	2	Initial preference for flexible and maximum power per unit. Do not want to store more units than they anticipate using. Added value of additional, smaller M5 units for ease of deployment by a single person.
Blue Lake Rancheria	10	0	Preference for maximum solar and identical systems.

W=watts
Source: GRID Alternatives, Merlin Solar, ONYX Power

Transfer Switch Installation

For designated medically vulnerable residents and critical loads at community facilities, manual transfer switches were installed to serve building loads with backup power through the building's existing electrical panels. Critical load identification and choices were made during the installation/wiring process:

- **Blue Lake Rancheria:** One transfer switch was installed at a Tribal residence equipped with a MORBUG unit. The Tribe's electrical and facilities team decided that it may install its own additional transfer switches in the future. Generator-ready meter collars may also be requested as an option from PG&E in parallel.
- **La Jolla:** GRID Alternatives San Diego installed transfer switches (30 Ampere Hubbell Out and Generator Interlock Kits) at three La Jolla households designated by the Tribe as housing medically vulnerable residents. One additional residence was allotted a MORBUG unit for a medically vulnerable resident but with connection through cords directly to the Rhino, given some concerns about the building's aged electrical system safety.
- **Soboba:** The Tribe declined transfer switch installations. Priority loads may be identified in the future and the Tribe might install panel connections as appropriate, separate from this project grant.

Permitting of transfer switches included review by the local Tribal authority and Rule 21 notification to the local investor-owned utilities for non-export emergency/standby generators. The specific process for each IOU is as follows:

1. SCE (Soboba) — online portal, submitting a notification application.
2. SDG&E (La Jolla) — permanent emergency/standby generator notification.
3. PG&E (Blue Lake) — notification only for pre-approved developers.

CHAPTER 3:
Use Case Analysis for Community-led Applications

A key advantage to the Rhino system is the ability to accommodate a wide range of use cases and paired technologies, some of which were discovered and derived from the community input throughout the project. The project team's commitment to exploring additional technology advancements has been a particular compliment to the Rhino system. With the Rhino system, it is possible to safely connect to existing, normally grid-tied, renewable energy assets (for example, single family or community-based PV arrays) within the community; and there is an option to leverage existing microgrids for renewable recharging in two of the host communities selected for this grant. While the option to charge the Rhino from existing renewable assets or microgrid infrastructure has the potential to be a highly beneficial and cost-saving model to explore, the more predominant uses were the pairing of portable renewable generation components of the project, which will stand on their own and provide substantial benefits to the community without any additional training or modifications. Any additional renewable generation capacity to be added will be subject to community approval, serving only as an optional value and a use case to test and document, without compromising the core use cases and overall demonstration of the project in any way.

Priority use cases were defined within each community by facilitating remote and in-person community meetings, presentations, demonstrations, and events. The project team maintained a cadence of regular meetings, with all three communities anticipating system deliveries and determining medically vulnerable residents and critical loads as well as off-grid non-emergent use cases. Community events were planned and supported for awareness and education, and each event allowed for the communities to collaboratively brainstorm creative ideas and priority loads and locations for local benefit from system uses.

Emergency Use Cases Identified:

- Medically vulnerable residents: support CPAP (continuous positive airway pressure) equipment, refrigeration of food and medication, air purification, air conditioning, lighting, phone, computer, oxygen machine, television, and other loads*
- Traffic control and lighting at the community fuel station during outage or PSPS
- Well pumps or infrastructure
- Mobile emergency operations trailer
- Firehouse critical facilities
- Fire, police for communications equipment
- COVID testing and vaccination sites and first-aid facilities
- Gas station coolers for medication
- Air filters (prevalent and necessary in fire/smoke situation)
- Space heating*

**with guidance on the limits of power*

Emergency Experience to Date:

- Soboba Band of Luiseño Indians: Power outage on Thanksgiving Day, November 2022; Rhinos were briefly used.
- Blue Lake Rancheria: Earthquake outage in Humboldt County, December 2022; systems were deployed.

Urgent use distribution plans are being further developed at each site.

Daily Use Cases:

In addition to emergency deployment, units are available for non-emergency applications, including but not limited to:

- Campground lighting and events
- Public works, such as the Water Department, working in remote locations
- Construction in off-grid locations
- Use on trailer/truck for mobile use
- Musical entertainment
- Garden equipment and machinery
- Holiday events, such as inflatable decorations and entertainment, burns, lighting
- Funerals, such as lighting and limited heating
- Tribal entry gate
- Clothing burning event
- Bouncy house fun
- Outdoor movie
- Personal device charging
- Refrigeration
- Ice maker
- Tribal elders living in off-grid locations

Deployment Testing and Verification

Use cases were tracked through central management/distribution at each community. For each use, data to be collected included but was not limited to:

1. Duration
2. Power output/loads
3. Weather conditions, temperature, status of the grid

The following instructions were provided to communities:

1. A Quick Start Guide, with instructions for the normal start-up and operations of the ONYX Rhino system (Appendix B).
2. Instructions for the Panther setup and connection to Rhino (Appendix E).
3. Instructions for connecting the Rhino to the transfer switch (Appendix F).
4. A Rhino Run Menu showing energy use for household items, to guide load choices (Appendix A).

Additional Deployment Activities

The project team:

- Delivered all battery and solar systems, as well as replacement parts, to the Tribes.
- Assessed sites for transfer switch locations and installation plans for each Tribe.
- Continues to expand use cases in each tribal community.
- Provided wiring connections for all Rhino battery and solar unit interconnections.
- Installed data logger measurement devices and verified communication protocol for sampling in community uses.
- Exchanged, tested and returned two Rhino units to determine the cause of a loss of power; discovered a System on Chip (SOC) firmware issue originating with the original equipment manufacturer of the component.
- Created instructional documentation for updating firmware on the unit display to remedy the faulty SOC readings.
- Trained residents with panel interconnects.
- Repaired one Rhino outlet damaged in handling.

Use Case Assessment

Energy Resilience:

Critical facilities were discussed and considered with each Tribe; however, specific loads were not designated as priorities for the system uses. Centrally located facilities can be supported by mobile units without installation of transfer switches. This allows for flexibility in supporting critical communication, lighting, and refrigeration loads without matching the system to the full building energy profiles.

Household resilience garnered significant interest, with systems primarily designated for priority, medical, vulnerable, and/or elder households. Tribes must determine deployment and recipients in the context of priorities in the community, alternative energy sources, and more permanent solar and storage options in development.

Emergency Use:

While there were fortunately no extreme energy emergencies during the project period at the Tribe locations, this did not allow for the fullest experience of the system for energy resilience. In recognition of the value of the systems and mobility, Blue Lake Rancheria expressed interest in deploying systems to other Tribes in its surrounding area as needed for emergency response.

Mobility:

Deployment for community events is often managed by a single individual, highlighting the required ease of handling. New, more portable ONYX M5 solar units were provided to the La Jolla Band of Luiseño Indians to accommodate this use case.

Lessons Learned

1. Rhino units are heavy and tall and challenging to move without multiple people or assistive devices, making deployment for community events difficult.
2. The quiet system is a benefit, but users don't realize the unit is on.
3. Sources for deployable solar at sufficiently high voltage and power were scarce, and large blankets are cumbersome to handle. In response, ONYX created a smaller solar option of the Manta and M5 units.
4. A "15-minute rule" target was achieved with systems as deployed, provided they are on location.
5. Tribal governance, organizational approach, and technical capacity are unique to each Tribal nation.
6. Community-specific logistics and emergency response plans are fully in the purview of each Tribe.
7. Effects of COVID-19 and world events limited in-person community engagement, impacted the supply chain, and increased shipping costs.
8. Data collection at Tribal locations needs to be planned within limits of remote use and intermittent Wi-Fi connection.
9. Existing forums, events, and community information channels should be leveraged as available and appropriate.
10. Transport and lift equipment may be required for rapid "last mile" deployment, based on geography and terrain.
11. Each community has unique factors, resources, and benefits from customization, including site staging and storing considerations for Rhinos + solar being centralized or decentralized.
12. Visits with vulnerable residents are best initiated by Tribal project leadership. Introductions of limited outreach and construction team as appropriate and necessary allowed for residential transfer switch installation.
13. Dispersed housing and rough terrain can make the distribution of systems challenging, particularly for a single responsible individual.
14. Project success depends strongly on engaged community champions. Staffing changes and limited terms of Tribal Council members necessitate repetition of project goals, interests, education, and coordination for impact.

15. Extended operation duration and more capacity flexibly deployed in real time on-site spurred development of ONYX X-Packs.
16. The product combination of Rhino + mobile solar is ready to scale for broader deployment, with some improvements into next-generation product design incorporating these lessons learned.

CHAPTER 4:
Community Engagement and System Training

Community Stakeholders

An essential aspect of this project has been the engagement with a diverse group of stakeholders across the three partner communities. That engagement proved crucial for the successful implementation of the ONYX Rhino technology, and it encompassed a range of key participants, including:

1. Tribal leadership
2. Tribal emergency response team
3. Tribal community members
4. Tribal residents
5. Vulnerable/prioritized residents for medical and other needs
6. Staff servicing
7. Emergency service coordinators/utility liaisons
8. Critical facilities operators and users
9. Trainees supporting technology
10. System/project owners and coordinators

The involvement of stakeholders was instrumental in ensuring the technology's alignment with community needs and enhancing resilience against potential power outages. Tribal leadership was at the forefront, playing a crucial role in decision-making and endorsing the project. The Tribal emergency response teams were integral in merging the technology into emergency response plans. Tribal community members and residents, as direct beneficiaries, provided invaluable feedback, ensuring that the technology aligned with their needs and preferences. Special attention was focused on vulnerable or prioritized residents, especially those with medical needs, to guarantee that the technology addressed the most critical community requirements.

Staff servicing and emergency service coordinators/utility liaisons played a key role in maintaining operational effectiveness and ensuring the technology's alignment with existing emergency and utility frameworks. Critical facilities operators and users offered insights critical to supporting essential services during emergencies. Trainees supporting technology were pivotal for future workforce development, ensuring the project's sustainability. Lastly, system/project owners and coordinators were responsible for overseeing the project's overall management and success. The engagement of these stakeholders was vital, not only for gathering diverse insights but also for ensuring the effective integration of the technology into the community, thereby enhancing community resilience and emergency preparedness.

Highlighting cost savings, improved air quality, and safety, the project explored diverse applications of mobile generators, from individual home backups to off-grid power services. The ONYX Rhino technology played an important role in supporting community resilience by

providing backup power, demonstrating the ease of deploying renewable systems and strengthening Tribal emergency plans and resources. The project also studied and tested for the best use cases for mobile generators in various scenarios, including critical resilience and off-grid applications. Overall, the project helped empower communities with sustainable energy solutions, thereby enhancing resilience and raising awareness of the benefits of renewable energy.

Goals of Engagement

Engagement of target community stakeholders educated and empowered Tribal members with information about the project and sought the communities' input, support, and feedback during all stages of the project. Activities provided education, training and support to the community members through existing, long-standing relationships with residents and Tribal liaisons. The following activities were conducted to meet the overall goals of engagement.

1. Discussed community resilience with Tribal partners to engage in meaningful conversations about their capacity to withstand and recover from emergencies. These discussions aimed to identify specific needs and strengths, fostering a deeper understanding of how renewable energy solutions, like the ONYX Rhino technology, could enhance their resilience.
2. Dedicated energy education to enhancing the understanding of renewable energy technologies among Tribal communities. This involved providing comprehensive information about the ONYX Rhino system, its operation, and its benefits, thereby empowering community members with the knowledge to effectively utilize and advocate for sustainable energy solutions.
3. Provided appropriate benefits (maximize benefits during an outage and match community needs). The project benefits residents residing in high fire threat/PSPS zones who are members of the Tribes being served. While larger community benefits will be realized, the primary beneficiaries will be residents who are prioritized for services by the Tribal council and/or Tribal leadership themselves, including members who require medical equipment, are elder or otherwise vulnerable, and with critical energy needs as determined by the community leadership. Larger community benefits also serve households by properly educating and engaging all community members on the project's goals of providing backup power to critical infrastructure as well as to residents' homes. The education around the best use for each system was bi-directional; the community received information and training on the Rhino system's application, and, in turn, the community provided feedback and additional use cases on the most urgent need during specific outages and emergencies, all while accounting for the flexibility to use portable, renewable generation for multi-day outages and the possibility of connecting to existing energy assets in the community.
4. Educated local residents about the project, increased local buy-in, explored additional use cases, and reduced any distrust of outside companies, a barrier of clean energy adoption within low-income communities and Native American Tribes in particular.

5. Ensured that the system benefits to the community are maximized during both grid-tied and off-grid emergency and/or grid outage situations. Equipped each Tribe with the systems and with the knowledge and training needed to perform the successful operation of the system in all use cases.
6. Deployed systems following initial community engagement activities, with flexibility to address the specific community needs and best use cases determined by the community engagement activities. Acknowledged the continuing challenges of COVID-19 and the value of in-person engagement. Continued activities concurrently with deployment, measurement, and verification to maximize interactive opportunities.
7. Demonstrated the range of benefits provided by the systems through coordinated data gathering. This included measurement, verification, and evaluation of project benefit deliverables, incorporating community feedback and information regarding the project's success metrics.

Engagement Activities

Throughout the duration of this project, a comprehensive and dynamic range of engagement activities were undertaken to ensure deep and meaningful involvement of the Tribal communities. To foster collaboration, education, and empowerment from the outset, the project team:

- Partnered with the Tribal communities from the start of the project, beginning with the grant application.
- Conducted, with project leadership, kick-off webinars with for each Tribal community.
- Maintained open communication and regular check-ins with community project leadership throughout the project.
- Leveraged outreach within the community according to existing channels and processes.
- Created and distributed communication flyers to each Tribe profiling the project.
- Developed and distributed educational and instructional resources, including an Energy Education Run Menu (Appendix A) and online energy tool https://www.onyxpower.io/calculator for system energy consumption and load choices, Quick-Start Guide (Appendix B), Storage Procedure (Appendix C), operations and maintenance instructions; in addition, both in-person and remote training was provided.
- Integrated education activities and materials into community events.
- Invited identification of medically vulnerable residents and supported assessment of the match of load needs and appropriate transfer switch installation.
- Communicated directly with priority residents, as facilitated by the Tribal project team, ideally in person.
- Encouraged each Tribe to identify priority facilities to be served by systems.

- Developed graphics and descriptive materials to share at events, on site in community locations, and via electronic platforms (website, apps, email, social media).
- Elevated community-originated ideas and use cases.
- Presented workshops and community meeting sessions in community centers or a centralized location, to allow for education materials and project presentations to be transferred in a manner that minimized confusion and allowed for community members to have multiple opportunities to participate and understand the project's objectives.
- Studied and tested use cases and application of mobile generators with each community.
- Solicited feedback on uses and lessons learned through surveys and communication with project leaders and those residents directly served.
- Provided documentation and training as resources for integration into Tribal updates to emergency processes.
- Provided workforce development to train local community members in operations and maintenance of long-lasting units.
- Provided trainings to Tribal membership, council members and staff, technical operations and electrical teams, local learners, external energy partners, and emergency response agencies.
- Provided trainings in operations and maintenance and component replacement, along with documentation that included a confidential disclosure of internal components with Tribal mutual nondisclosure agreements.
- Developed a paper survey for feedback, which incorporated multiple use options and motivations, and queried community leaders for feedback in multiple modes.
- Engaged community attendees at events with the MORBUGS with operating systems and a creative idea survey for use case interests.
- Participated with Tribal staff and members in knowledge transfer events.
- Showcased the systems at fire safety events, Earth Day events, and cultural gatherings, including Trunk or Treat/Halloween celebrations and cultural burns.

Notably, events were often rescheduled due to COVID, heat, fire, and rain. This is indicative of Tribal rural realities served by the systems. COVID-19 continued to impact the team and Tribal communities and to limit in-person interactions and some communication with communities. Community engagement continued to evolve along with the deployment of systems with a more flexible timeline.

Once events were possible, there was substantial value in conducting in-person, interactive, community engagement events, demonstrations, presentations, and training with each community. These included family friendly Earth Day events, in-depth staff trainings with appropriate members of the facilities hosting the units, and a long, deep engagement with the

households that had units located to serve their personal loads. The in-person trainings were critical to achieving an operational understanding of both how the units are to be used and how to perform basic troubleshooting and maintenance procedures to ensure the systems last as long as possible and experience minimal downtimes.

Figure 6 through Figure 11 show pictures of the Rhinos from this project. Figure 12 shows some of the community feedback received.

Figure 6: Blue Lake Rancheria Project Flyer

Source: GRID Alternatives, ONYX Power

Figure 7: Earth Day 2022 Event Demonstration at Soboba Band of Luiseño Indians

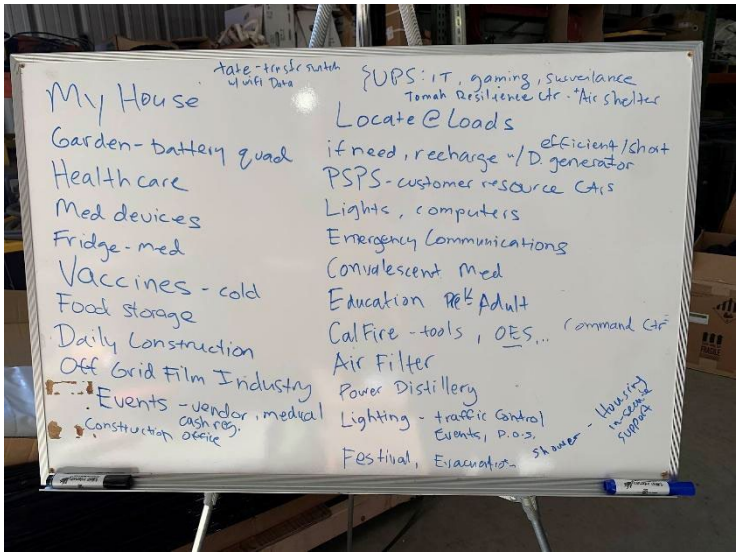
ONYX Rhino, with Panther solar blanket included, powering cooler, bouncy house, and rechargeable devices.

Source: GRID Alternatives

Figure 8: Training in Operations

Source: GRID Alternatives

Figure 9: Blue Lake Rancheria Community Education and Engagement



Top and bottom left: System demonstration to Tribe and local partners.
Bottom right: Use case brainstorm.

Source: GRID Alternatives

Figure 10: Soboba Band of Luiseño Indians Community Education and Engagement

Left: Community demonstration. Right: Tribal Council and project team.

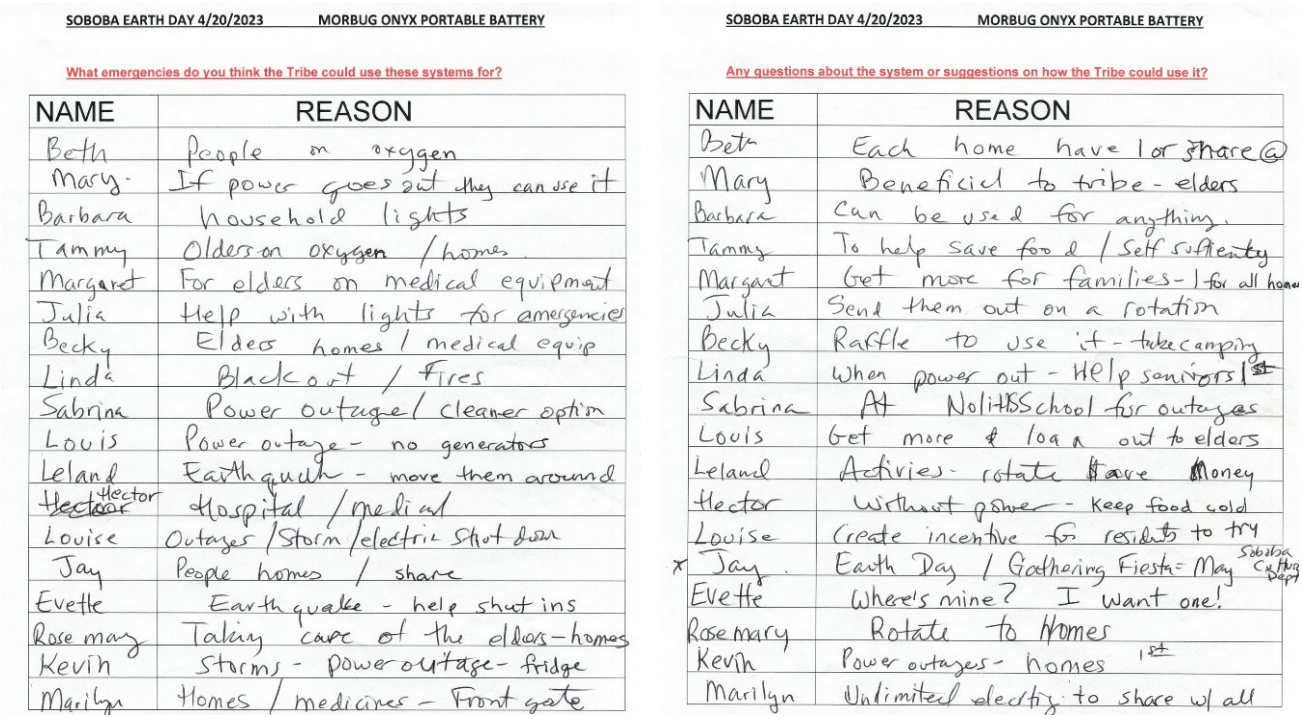
Source: GRID Alternatives

Figure 11: La Jolla Band of Luiseño Indians Community Education and Engagement

Left: Education and engagement events with Tribal staff, members, and Tribal Council. Right: Fun use demonstration.

Source: GRID Alternatives

Figure 12: Community Input on Use Cases from Earth Day 2023 at Soboba Band of Luiseño Indians



SOBOBA EARTH DAY 4/20/2023 MORBUG ONYX PORTABLE BATTERY

What emergencies do you think the Tribe could use these systems for?

NAME	REASON
Beth	People on oxygen
Mary	If power goes out they can use it
Barbara	household lights
Tammy	Olders on oxygen / homes
Margaret	For elders on medical equipment
Julia	Help with lights for amergencies
Becky	Elders homes / medical equip
Linda	Blackout / Fires
Sabrina	Power outage / cleaner option
Louis	Power outage - no generators
Leland	Earthquake - move them around
~~Hector~~ Hector	Hospital / medical
Louise	Outages / Storm / electric shut down
Jay	People homes / share
Evette	Earthquake - help shut ins
Rose mary	Taking care of the elders - homes
Kevin	Storms - power outage - fridge
Marilyn	Homes / medicines - Front gate

SOBOBA EARTH DAY 4/20/2023 MORBUG ONYX PORTABLE BATTERY

Any questions about the system or suggestions on how the Tribe could use it?

NAME	REASON
Beth	Each home have 1 or share @
Mary	Beneficial to tribe - elders
Barbara	Can be used for anything.
Tammy	To help save food / Self sufficiency
Margaret	Get more for families - 1 for all home
Julia	Send them out on a rotation
Becky	Raffle to use it - take camping
Linda	When power out - Help seniors 1st
Sabrina	At NolitaS school for outages
Louis	Get more & loan out to elders
Leland	Activies - rotate Save Money
Hector	Without power - keep food cold
Louise	Create incentive for residents to try
Jay	Earth Day / Gathering Fiesta = May Soboba Culture Dept
Evette	Where's mine? I want one!
Rosemary	Rotate to Homes
Kevin	Power outages - homes 1st
Marilyn	Unlimited electric to share w/ all

Source: GRID Alternatives, Soboba Band of Luiseño Indians

Community Questions Asked (Examples)

1. How much does it weigh?
2. How much does it cost?
3. Can I buy one directly?
4. Does it come in other colors than black?
5. Who gets these?
6. Can we use it to lower our electricity bills?
7. Can you make it smaller? Is there a smaller version? (Handling or energy)
8. What can I power with this? [Reference Run Menu examples]
9. How long does it run?
10. How long do these units last? [Lifetime usability is anticipated to be 10 years.]
11. Who will take care of these after the grant? Do we get trained? How do we replace parts?
12. Can we buy spare parts directly? How much do they cost?
13. How is this different than a Tesla Powerwall?
14. If I have solar on my house, can I charge the Rhino with that solar?
15. Can the Tesla Powerwall funding be used for these?
16. Is there any fire data? What do you do if it catches on fire?
17. Are these only for emergencies?
18. How many Rhinos/solar mats can you connect together?
19. What happens when the Rhino gets too hot?

CHAPTER 5:
Product Improvements and Technology Transfer

The following section outlines the primary objectives and results from the product advancement and technology transfer initiatives stemming from this project. The collaborative efforts between ONYX, the project team, community stakeholders, emergency response organizations, and policymakers are forging a path towards a more equitable and environmentally responsible energy future. The success and learnings from this project not only help demonstrate the viability of battery electric alternatives to traditional generators but also lay the groundwork for future innovations in energy technology.

Participation in Related Workshops

With the intention of presenting the specific findings of the project, the team actively engaged with various stakeholders and disseminated information. The team made concerted efforts to reach out to, and collaborate with, different sectors of the community, ranging from emergency response units to energy equity leaders. These engagements, which encompassed an array of activities such as expos, demonstrations, and specialized workshops, underscore the commitment of ONYX and the project team to not only develop cutting-edge solutions but also ensure their practical applicability and integration into local and regional systems. Below are the highlights of these multifaceted engagement initiatives, illustrating a holistic approach to fostering resilience and innovation.

- Engaged with local and regional critical facilities staff and trade groups, including fire stations, medical stations, the Office of Emergency Services, the Federal Emergency Management Agency, and other emergency response operations.
- Participated in relevant trade expos, including the Natural Disaster Expo in November 2022, where ONYX Power presented on the work completed in the MORBUG Project and where Tribal representatives shared their reflections on the project.
- Demonstrated systems at an ONYX community event in the Del Rey municipal park, with Rhino and Panther powering bouncy houses and a sound system (Figure 13).
- ONYX participation and Rhino use at a GRID Alternatives IE regional office event attended by community representatives and award-winning energy equity leaders.
- Planned, attended, presented at, and engaged in knowledge transfer activities at the Blue Lake Rancheria Smoke, Air, Fire, Earthquake (SAFE) Symposium in connection with the Schatz Energy Center.

Figure 13: Expositions

Left: At the Del Rey municipal mark powering a sound system. Right: The ONYX Power team at the Natural Disaster Expo.

Source: GRID Alternatives, ONYX Power

Resource Improvements and Product Iteration

While the ONYX products were already commercially available, the deployment in and the feedback from the Tribal communities have informed design improvements for future product development. ONYX developed and iterated on manufacturing, shipping, and logistics procedures and processes throughout the course of the project. These iterations will develop a larger pool of internal knowledge that will be used to scale operations for future deliveries.

Key learnings include the following.

- The primary concern for most of the Tribal communities was the size/weight of the Rhino. While portable, it weighs over 300 pounds (lbs) and typically requires special equipment to lift into the back of a vehicle. It has also been observed that the full 6-kWh capacity has rarely been drained by operation, especially when coupled with solar panels. This implies that some small reductions in energy capacity, if they result in meaningful weight reductions and increased mobility, would be valuable to users.
    - In response to this consistent feedback, the ONYX team pursued a product redesign, from the 4-kW/6-kWh and 325-lb Rhino that was deployed as part of this MORBUG Project to the new 4-kW/5-kWh, 220-lb "R5" unit (Figure 14). The new R5 mobile power system delivers a 32-percent reduction in weight versus the original Rhino while maintaining most features and even improving select features. The R5 is shorter and smaller than the original Rhino, making it easier to mobilize and site. While 220 lbs is substantial, the 32-percent weight reduction of 105 lbs enables easier lifting of the ONYX R5 into and out of vehicles.

- Acknowledging that the full 6-kWh capacity of the Rhino was rarely used, the redesigned R5 traded a 32-percent weight savings for an 18-percent reduction in energy capacity. To compensate for this, and to further improve mobility and modularity, ONYX developed and now offers battery expansion packs (X-Pack) in two different sizes: the X5 (5 kWh) and the X10 (10 kWh), which weigh approximately 100 lbs and 200 lbs, respectively. The X5 and the X10 are in similar wheeled cases and "plug-and-play" connect, both to the new R5 and the currently deployed Rhinos, with a touch-safe cable that can be inserted only one way. Simply connecting an X-Pack to the Rhino or R5 adds additional energy to the deployment and does so in manageable increments.

- A key benefit of the Rhino systems is their silent operations, but it has been noted that this quietness makes it difficult for users to know if the equipment is "on," and several Rhinos have been left on long enough that they self-discharged to an inoperable state of charge. They are recoverable, and recharge/recovery processes were developed and shared with the Tribes. This suggests that additional "on" status indicators (for example, lamps and screens) may benefit users in future iterations of the systems.
    - In response to this feedback, the ONYX team implemented several improvements to the R5 that include: an ON/OFF indicator lamp; an automatic AC OFF function that stops the R5 from discharging below a certain state of charge percentage; and integration of a 4G-capable module that can send automated emails to key personnel when the battery system reaches certain voltage or state of charge percentage limits.
    - ONYX also simplified the ON/OFF switch on the new ONYX R5, based on operational feedback from the Tribal communities participating in the MORBUG Project. The previous iteration required a two-step sequence that could accidently be performed incorrectly, causing the Rhino to go into "protection" mode and require a reset. The new sequence is a one-step ON/OFF toggle that can be executed in only one way and requires no instructions, considering that most people are familiar with ON/OFF switches.

Additionally, lessons were learned about whole-home transfer switches and dedicated load panels. Both fossil fuel generators and transfer switches are supplied with options of floating-neutral or neutral-bonded configurations, but nearly all fossil fuel generators lack intelligent controls to determine if they were paired with the incorrect type of transfer switch; the generators will push out power regardless of the correct or incorrect transfer switch configuration. This is not the case with intelligent power electronics, which will check for proper neutral-ground switching at the transfer switch. As a result, better details are needed when specifying transfer switch equipment for use with portable battery-based power systems.

Figure 14: Design Iteration to Smaller Unit

Source: ONYX Power

Scalability

ONYX demonstrated through the MORBUG Project that delivering systems on (and ahead of) schedule can be accomplished with a relatively small and trained labor force that is easily scalable due to the low-to-moderate skill levels needed and a manufacturing process that does not rely on special machinery. A single ONYX Rhino can be assembled in approximately four hours by a technician trained for two weeks. Scale for these types of systems is driven by demand for the product, and there are two immediate opportunities for greater market adoption of mobile zero emissions power systems based on the learnings from the MORBUG Project:

- Streamline the path for mobile battery systems as drop-in replacements for gas generators at residences. This was done for select homes in the Tribal communities, using standard "generator" transfer switches or the equivalent. This avoided the lengthy permitting and interconnection processes required when non-Tribal authorities and other utilities have jurisdiction.
- Increase public awareness, comfort, and experience using mobile battery systems as replacements for small gas generators in non-emergency situations (for example, events and construction).

ONYX has had the opportunity to articulate future manufacturing and expansion plans, along with cost forecasting.

Technical Advisory Committee

Technical advisory committee (TAC) members for this project included members of multiple Tribes; representatives from the California Air Resource Board (CARB), including the

manufacturing liaison for mobile power and policy advisor; consultants developing Tribal projects; mobile emergency system operations innovators; and utility technology managers and design consultants. The TAC reviewed and provided input on project implementation, measurement and verification, knowledge transfer, use case expansion and product exposure, and technology and knowledge transfer. The project team planned and conducted two TAC meetings, with the second focused on use case expansion and technology transfer and including CEC commission agreement managers of other MORBUG projects. The TAC takeaways and impact on project activities are summarized in Table 3.

Table 3: Technical Advisory Committee Input and Impact

TAC Meeting	Committee Input	Impact
#1	Tribal uses will vary by Tribal specific community architecture and needs; each Tribe is different.	The project team observed and respected this reality. Blue Lake Rancheria (BLR) was used for specific emergencies and outages while La Jolla was used for events and residents.
#1	Demystify renewable energy with fun uses: power music stages, power bouncy house. Engage in fun young age knowledge transfer.	Tribes used Trunk or Treat Halloween events in 2022. ONYX has: powered sound stages for a Del Rey Neighborhood Council community event and a Bezos Earth Fund Greening U.S. Cities event; powered bouncy houses for Soboba Earth Day (Figure 15) and other inflatables for music and event company Goldenvoice at music festivals (Figures 17 and 18); and helped demystify renewable energy with the Run Menu and an online calculator on the ONYX website (www.onyxpower.io/calculator)
#1	Navigate who gets limited access to units (there's not enough for everyone); triage with a thoughtful approach and stakeholders.	The project team provided guidance but ultimately left it up to each Tribe on how to site, distribute, and use units. La Jolla Tribal communities chose to site units directly at homes, while BLR and Soboba Tribal communities kept a central depot of units for deployment.
#2	Quantify the ONYX solar unit efficiency: 15 to 18 percent overall, 21 percent at panel level.	ONYX has redesigned Manta to the new M5, incorporating even higher efficiency and more durable military-grade PV panels.
#2	The SAFE Symposium, Rural and Tribal Community Resilience: Strategies for Action, presents an event opportunity.	ONYX traveled to and attended the SAFE Symposium at BLR to represent clean energy technologies.

TAC Meeting	Committee Input	Impact
#2	Are there diesel light towers used in the communities where the Rhino is being deployed currently?	ONYX equipment has been rented by music and event companies to power lighting towers and other event lighting.
#2	More engagement with utilities, construction operators?	The Los Angeles Department of Water and Power (LADWP) and PG&E are actively engaged with ONYX, LADWP for specific use cases and PG&E for technology integration (backup power transfer meter collar).
#2	CARB Clean Off-Road Equipment Voucher Incentive Project (CORE) eligibility?	ONYX equipment is not a precise fit for CORE, although a new lawn equipment category has opened. Instead, CARB is launching the Small Off-Road Engines (SORE) program and ONYX is the first company to be applying for the zero-emissions generator credit program.

Source: GRID Alternatives

Figure 15: Fun, Quiet, and Safe Replacement of Diesel Generator

Source: GRID Alternatives

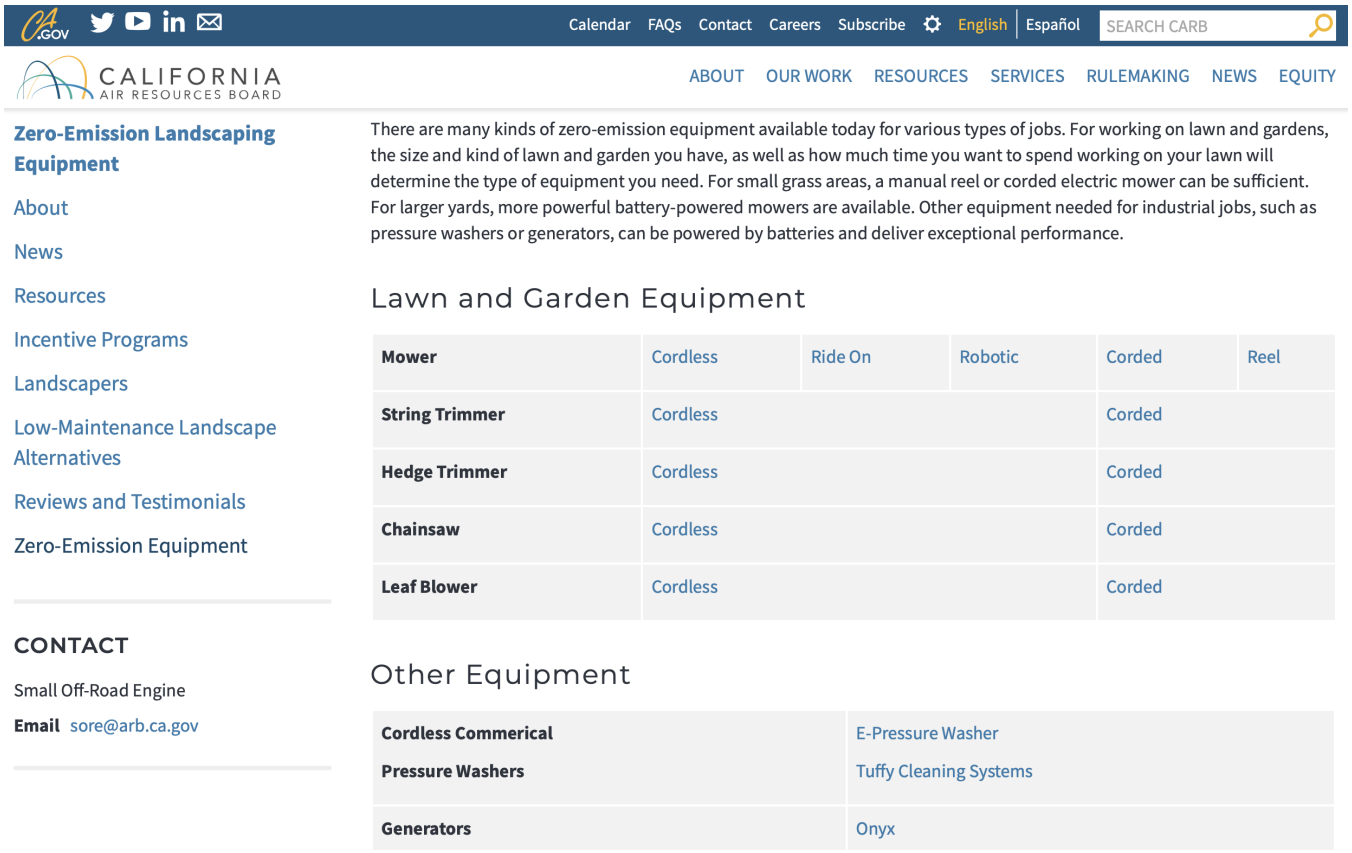
Showcasing Renewable Energy Innovations and Collaborations

Building upon the robust foundation laid by the TAC and the Tribal partners, the project team focused on a series of influential initiatives and collaborations that further cement the pivotal role and profound impact of the MORBUG Project. The project team's endeavors included

participating in key forums, achieving significant milestones in equipment innovation, engaging in community-focused demonstrations, and receiving national recognition. Collectively, these efforts highlight the growing integration of sustainable energy solutions across diverse sectors, underscoring their importance in environmental stewardship and resilience.

- WRISE: Women of Renewable and Sustainable Energy Leadership Forum, Minneapolis, MN: On October 11, 2023, GRID Alternatives presented on a panel, Building Local Power and Resilience with Microgrids/DERS (distributed energy resource systems), referencing MORBUGs as a "rugged mobile nanogrid" along with other projects.
- ONYX was the first-ever generator equipment listing on CARB's website under Zero-Emission Equipment — Other Equipment (Figure 16) (CARB, 2023).

Figure 16: California Air Resources Board Website



Source: California Air Resources Board

- ONYX posted a "how-to" video on YouTube as part of a submission to the federal Department of Homeland Security's "Clean Power for Hours" Challenge. The video demonstrated the easy setup of ONYX's mobile nanogrid with a home's manual transfer switch: https://www.youtube.com/watch?v=QfGofRePCE8&t=14s. As a result, ONYX was selected as one of nine award-winning finalists nationwide in January 2024 and was a top five "Honorable Mention" Grand Prize awardee in April 2024 (DHS, 2024).
- ONYX has supplied Rhinos, R5s, X10s, and M5s to Goldenvoice for four multi-day music festivals (CaliVibes, Just Like Heaven, Cruel World, Head in the Clouds) to power

lighting, point-of-sale systems, large displays, and inflatables (Figures 17 and 18). Goldenvoice and its parent company AEG Worldwide sought to reduce their environmental footprint by replacing small generators with rented ONYX equipment (February to November 2023).

- ONYX systems, built in the United States, qualify for a 40-percent federal investment tax credit (ITC) under the Inflation Reduction Act (IRA), with up to an additional 10-percent bonus available (a total of 50 percent) for low-income and Tribal communities. Not-for-profit entities may, for the first time with the IRA, receive an ITC direct pay option from the federal government instead of being excluded due to the structural absence of tax liability for not-for-profit entities (August 2022).
- The CEC EPIC Symposium featured a Tribal representative, a recipient of MORBUG units for the La Jolla Tribe, speaking on the Environmental Justice Panel.
- A GRID Alternatives IE proposal with the City of Coachella included ONYX in pursuit of Strategic Growth Council funding, with the notice of proposed award scheduled in December 2023.
- Onyx conducted a live, in-person demo for Pacoima Beautiful for a mobile office conversion into a resilience center using R5, X10, and M5 units (November 2023).
- PG&E reached out to ONYX for technology integration with PG&E's in-house-developed backup power transfer meter collar and the ONYX R5 (July 2023).
- ONYX met with the California Department of Social Services (Disaster Services Branch) to showcase the ONYX mobile nanogrid capabilities for disaster and emergency relief (July 2023).
- ONYX engaged in workforce development discussions with community colleges and advocates with a training interest, with the potential to leverage batch production into electrical certification as a paid training component.
- CalTestBed selected ONYX in 2023 as a voucher awardee, with University of California (UC), Riverside's CE-CERT as the test facility. The CalTestBed voucher is intended to perform expanded full mobile nanogrid function and durability tests (CEC funded).
- ONYX participated in the Energy & Facilities Vendors fair sponsored by California State University, Dominguez Hills (November 2023).

Figure 17: ONYX Powering Festivals

Top: Powering large, illuminated inflatable. Bottom right: Powering major lighting display. Bottom left: Emergency egress spotlighting.

Source: GRID Alternatives

Figure 18: Above-ground and Underwater Area Lighting

Source: GRID Alternatives

Future Technology and Knowledge Transfer Activities

Media Engagement

Through both GRID Alternatives and ONYX Power media channels, the team will focus on information dissemination as a pivotal strategy towards awareness and adoption of the Rhino technology. Leveraging various media channels to chronicle the progress and success of the project, the project team will conduct a concerted effort to reach wider audiences, from industry professionals to the general public. A multi-faceted approach will ensure that key messages are conveyed across diverse platforms. Following are the key aspects of this media outreach initiative:

- Press releases on the project's progress and its successful completion.
- Social media publications.
- Tribal community publications.

Publications

Publications form a key aspect of the future technology and knowledge transfer activities associated with the project, which involves collaboration with UC Riverside. UC Riverside, being a public university, is held to strict public dissemination requirements and guidelines, and it is committed to making all nonproprietary project information and publications accessible to the public. This will be carried out through the university-managed websites and publication databases, allowing for transparency and broad sharing of the developed

knowledge. Additionally, key research findings and case study analyses will be compiled into comprehensive reports that reflect the novel insights and practical implications drawn from the project. These documents will be submitted to relevant workshops, conferences, and publication venues, thereby ensuring integration of the project's learnings into professional and public discourse. Furthermore, potential collaborations with other educational institutions and industry partners are anticipated to maximize the impact of the research. Engaging in these publication activities underscores the commitment to advancing understanding and utilization of the technologies developed through the project, with the ultimate aim of fostering innovation and enhancing energy resilience within the broader community.

Policy Development Activities

In the ongoing effort to support and advance clean energy policy, ONYX's involvement in various initiatives exemplifies a proactive and collaborative approach to policy development. The following activities highlight ONYX's engagement with state regulators, utilities, and Tribal communities, focusing on the design and implementation of clean energy programs. These interactions demonstrate ONYX's commitment to integrating the valuable insights gathered from the MORBUG Project into statewide policy initiatives. By doing so, ONYX aims to contribute to the formulation of more effective incentive programs, the fostering of innovative utility solutions, and the enhancement of climate resilience in the face of environmental challenges. The summarized activities illustrate the dynamic nature of ONYX's policy development pursuits.

- State Regulators: CARB is in the process of revamping its CORE program and will be unveiling the SORE program in a few years. ONYX has been in discussions with CARB staff around implementation needs for these programs and plans to continue, through public comments, utilizing the lessons from this MORBUG Project to help the state regulators craft effective incentive programs. Most recently, with the launch of the SORE Program, ONYX engaged CARB staff to determine how to apply for the zero-emissions generator credits offered by that program and appears to be the first generator manufacturer to attempt to do so, illuminating a path forward for CARB staff as well as other market actors.
- Utilities: ONYX will work with California (and other state) utilities to share lessons learned from the interconnection process (Rule 21 in CA) for this type of equipment, so that rapid deployable clean power can be an implementable solution. Additional utility programs could be developed, with input from the MORBUG Project, to make homes "backup ready," using best available practices and readily available equipment, such as transfer switches.
- Climate Impact and Tribal Engagement: Realities of climate impact limit communication and engagement opportunities with Tribes, with ready examples of heat, fire, wind, rain, flooding and accidental or planned power outages. This project supports necessary resilience. Emergency support is best when it is climate resilient. GRID Alternatives encourages the CEC to strengthen and expand the connection between emergency response and renewable energy.

CHAPTER 6:
Summary and Conclusions

GRID Alternatives, ONYX Power, and UC Riverside were able to successfully deploy fully operable, grid-independent, rapidly deployable, modular and expandable generation systems to enable California's Tribal and under-resourced communities to provide both critical electric resources when the grid is down, as well as reliable, highly mobile off-grid resources for facilities and services throughout the year. The partnership and collaboration between team members and community leaders led to rapid manufacturing and deployment, enabling more time and resources to be dedicated to gathering critical information and improved project performance. The project's goals were met well ahead of schedule and with close attention to community feedback, resource improvements, and technology transfer.

Rapid Production: Creative arrangements were made between project partners to ensure rapid production of the systems for early-stage system deployment.

Delivery: All 30 systems were successfully delivered to three Tribal communities ahead of the anticipated schedule.

Use Case Analysis: Multiple use cases were studied, providing valuable insights into the functionality and applicability of the technology.

Community Feedback: The Tribal community members provided critical feedback on the use, value, and training needed for the technology.

Adjustments and Service: Significant improvements were made to the technology after use case and community feedback analysis was completed. This included service trips and improvements to the training and operations related to the technology.

Follow-up Activities and Next Steps

The objectives intended to drive the technology advancement initiatives of the ONYX Rhino technology were successfully achieved. The follow-up objectives are intended to highlight how the ONYX Rhino unit contributes to energy resilience, sustainability, and innovation within the communities it serves. The key long-term objectives the project aims to achieve are to:

- Demonstrate critical load backup power for residents during grid outages and emergencies.
- Demonstrate the ability to provide deployable, clean power with solar-paired systems.
- Demonstrate the use of the ONYX Rhino as a drop-in replacement for mobile generation sources (small gas generators) for non-emergency services.
- Utilize additional funding opportunities to demonstrate resilience uses in new markets and applications.

By demonstrating the multifaceted applications of the ONYX Rhino, from whole-house backup power during emergencies to deployable clean energy sources and direct replacement for traditional generators, this project was able to gather valuable insights for continuous improvement and advancement of California's climate and resilience goals. Ongoing media engagement, publications, and policy development activities will be critical next steps to advancing this technology and application model. This mobile critical resilience model will advance mobile generation technology throughout California, while providing immediate, flexible and scalable relief to families that are suffering the most from the effects of wildfires and grid outages. The project team views this endeavor as a resounding success.

GLOSSARY AND LIST OF ACRONYMS

Term	Definition
30A	30 ampere
BANC	Bay Area/North Coast
BLR	Blue Lake Rancheria
CARB	California Air Resources Board
CEC	California Energy Commission
CORE	Clean Off-Road Equipment Voucher Incentive Project (CARB)
CPAP	continuous positive airway pressure
DERS	distributed energy resource systems
IE	Inland Empire
IOU	investor-owned utility
IRA	Inflation Reduction Act
ITC	investment tax credit
kW	kilowatt
kWh	kilowatt-hour
LADWP	Los Angeles Department of Water and Power
lbs	pounds
M5	ONYX Manta M5 mobile solar system
MC4	Multi Contact, 4 millimeter
MORBUG	mobile renewable backup generator
ONYX	ONYX Power
PG&E	Pacific Gas and Electric Company
PSPS	public safety power shutoff
PV	photovoltaic
R5	ONYX Rhino R5 mobile power system
SAFE Symposium	Smoke, Air, Fire, Earthquake Symposium
SCE	Southern California Edison Company
SD	San Diego
SDG&E	San Diego Gas and Electric Company
SOC	System on Chip
SORE	Small Off-Road Engines Program (CARB)
TAC	technical advisory committee

Term	Definition
UC	University of California
V	volt
VAC	volt alternating current
W	watt
X5	ONYX X5 battery expansion pack (5 kWh)
X10	ONYX X10 battery expansion pack (10 kWh)
X-Pack	battery expansion pack

References

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DHS (United States Department of Homeland Security). 2024 (Apr 22). "DHS Announces First Winners, Awards $835,000 'Clean Power for Hours Challenge' in Celebration of Earth Day 2024." United States Department of Homeland Security. Available at https://www.dhs.gov/archive/news/2024/04/22/dhs-announces-first-winners-awards-835000-clean-power-hours-challenge-celebration.

SCE (Southern California Edison Company). 2024. "Circuit Reliability Review - Soboba Band of Luiseño Indians." Southern California Edison Company. Available at https://edisonintl.sharepoint.com/:b:/t/Public/Misc/EYhMO9rzPmVApmY3AtOahocBkQfYKP2Zpr2IC2GSTbZqaA?e=Pn5y4c.

Project Deliverables

The following project deliverables were completed for this project:

- Community Engagement Plan
- Community Engagement Report
- Deployment Plan
- Deployment Report
- Measurement and Verification Plan
- Measurement and Verification Report
- Final Meeting Benefits Questionnaire
- Technology Transfer Plan
- Technology Transfer Report

Project deliverables, including interim project reports, are available upon request by submitting an email to pubs@energy.ca.gov.

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APPENDIX A: Rhino Run Menu

March 2025| CEC-500-2025-010

APPENDIX A:
Rhino Run Menu

ONYX

RHINO™ R64 - RUN MENU

HOW MUCH POWER DO I NEED?

- Fan: 10 watts
- Internet router: 15 watts
- Mobile phone: 75 watts
- Cordless drill: 80 watts
- Lights: 25-100 watts
- Laptop: 100 watts
- TV: 120 watts
- Gaming system: 180 watts
- Refrigerator: 70-200 watts
- Karaoke: 200 watts
- CPAP or Projector: 300 watts
- Pump (1.0HP): 750 watts
- Toaster: 1,250-1,500 watts
- Hairdryer: 1,500-1,800 watts
- Bouncy house: 2,000 watts

NOTE: ALL POWER SHOWN ABOVE IS ESTIMATED

HOW LONG CAN A RHINO RUN?

Great question - it depends on what you're running! Check out the "combos" below.

COMBO "A" – ALL GOOD FUN!

Want to **throw a party** with **karaoke** and a **bouncy house**?

Device	Power	Runs
Portable Fridge	70 watts	**1.5-2 hrs**
LED Lights	100 watts (x4)	
Karaoke	200 watts	
Projector	300 watts	
Bouncy House	2,000 watts	
TOTAL	**2,970 watts**	

COMBO "B" – BUSY WITH WORK

Need to **get work done** like **construction** and **field projects?**

Device	Power	Runs
Portable Fridge	70 watts	**4-6 hrs**
Cordless Drill	80 watts	
Laptop	100 watts	
LED Lights	100 watts (x2)	
Pump 1.0HP	750 watts	
TOTAL	**1,200 watts**	

COMBO "C" – CRITICAL POWER

Need to make sure your **essential devices are covered during a power outage?**

Device	Power	Runs
Fan	10 watts	**16-20 hrs**
Internet	15 watts	
Room Lights	25 watts	
Phone	75 watts (x1)	
Fridge	200 watts	
TOTAL	**325 watts**	

ONYX POWER LLC
www.onyxpower.io
hello@onyxpower.io

Source: ONYX Power

ONYX

RHINO™ R64 - RUN MENU

PRODUCT SPECIFICATION

This product must be maintained and utilized within the environmental conditions and operating limits specified below. Any applicable product warranty shall become null and void if product is subjected to and/or operated outside of these limits. Specifications are subject to change without notice.

Performance and Safety	
Nameplate Battery Capacity	7.6 kWh
Usable Battery Capacity	6.0 kWh (100%)
Maximum Cycles	10,000 cycles
Remote Monitoring	Yes; via Bluetooth phone app
Expandable Capacity	Yes; via paralleling Rhino units
Certifications	UL1973, EN/IEC 62109-1, CSA C22.2, No. 107.1-01 UL1741 Ed.2, FCC Part 15 Class B

Electrical	
Battery System Voltage	48VDC
Output Power	120 VAC and 240 VAC / 60Hz or 50Hz / 1 Ph
Discharge Power (Cont. / Peak)	4kW / 7kW (5 seconds) at 25˚C
Discharge Time @ 2kW / 1kW	3 Hours / 6 hours
Input AC Charging	120 VAC / 60Hz or 50Hz; 240VAC Optional
Input Solar DC Charging	2kW / 100VDC / 20A Max
Charge Time	4 Hours via 120V
Outlets	3 x 120V NEMA 5-15 (3-Pin) Outlets 1 x 240V L14-30R (30A)
USB ports	4 x 5V / 24W USB Connections
Solar Charging Capable	Yes
Back-up Power Switchover	<10ms

Physical and Environmental	
Operating Temperature Limits	0-40˚C / 32 - 104˚F
Storage Temperature Limits	6 Months: -10 - 25C / 14 - 77˚F 3 Months: -20 - 45˚C / -4 - 113˚F
Ingress Protection	NEMA 3R / IP54
Integrated Storage	17.5 L / 4.6 Gallons
Exterior Dimensions	1143x635x432 mm / 45x25x17 in
Weight	148 kgs / 325 lbs

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Source: ONYX Power

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APPENDIX B: Rhino Quick Start Guide

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APPENDIX B:
Rhino Quick Start Guide

ONYX

Rhino R64 Quick Start Guide

Overview of the Rhino

Figure 1: Rhino R64 Side View

Source: ONYX Power

1. Transporting and Handling the Rhino

- CAUTION: The Rhino is VERY HEAVY so please take great care while moving.
- CAUTION: Unless mobility is needed while the Rhino is running, make sure that the disconnect switch is in the OFF position before transporting.
- CAUTION: The Rhino should not be placed in standing water.
- CAUTION: Do not lay the unit face down on the side with the front container ("frunk" hatch) or on either side with the latches. The Rhino should remain upright or lay flat with the "frunk" facing upward.
- RECOMMEND: Use multiple people and appropriate lifting techniques / equipment such as hydraulic lift tables and lift gates when loading/unloading from vehicles.
- RECOMMEND: When inside vehicles, secure the Rhino to prevent movement during transport.
- RECOMMEND: Store all cables and accessories that were provided inside the front container ("frunk").

2. Before Using the Rhino

- Download the VictronConnect phone app so you can monitor the system operation and state of charge.
  - https://apps.apple.com/us/app/victronconnect/id943840744
  - https://play.google.com/store/apps/details?id=com.victronenergy.victronconnect&hl=en&gl=US
- Open the app and connect to the unit. The default password is the serial number of the unit, located on the nameplate around the red disconnect switch, with a "0" added in front (e.g. SN 12345 = PIN 012345).
- Make sure the unit is on a level surface and preferably shaded.

Figure 2: Victron Battery Monitor/ SOC Display

Source: ONYX Power

3. Using the Rhino

a) Place the Rhino in a shaded area while in use to minimize heating from direct sunlight. The Rhino will self-protect and perform a safety shutoff if the unit exceeds the internal temperature limit. See Product Specification for more information.

b) The Rhino must be turned "ON" before it can be used or charged. To do this:

i. Locate the DISCONNECT (ON/OFF) switch on the side of the unit.

Figure 3: Disconnect Switch

Rotate the DISCONNECT (ON/OFF) switch CLOCKWISE until the black arrow points to the "ON" position.

*Figure 4: Turning on the Rhino. Turn **CLOCKWISE ONLY***

ii. **CAUTION: the DISCONNECT must only be rotated CLOCKWISE in all situations. Failure to follow the above process may void any applicable warranty and cause the Rhino to perform a safety shut down that will require servicing by ONYX technicians in order to reset.**

c) USB: plug in desired devices into USB ports.

d) 110/120V and 220/240V: plug in desired devices into the appropriate outlet.

i. If the power draw is too high for too long, the system may self-protect and shut off. This is normal and the system will resume operation once it returns to normal operating conditions.

ii. When using outdoors, ensure that proper GFCI extension cords are used to provide power to equipment.

Source: ONYX Power

e) DO NOT ATTEMPT to open the Rhino enclosure. Doing so will immediately void any applicable warranty, may expose personnel to electrical hazards, and will violate the terms of the agreement with ONYX POWER LLC.

4. Turning Off / Storing the Rhino

a) Turn the Rhino "OFF" when not in use to save energy. Keeping the Rhino "ON" will slowly drain energy by using standby power.
   a. To turn the Rhino "OFF" locate the DISCONNECT (ON/OFF) switch on the side of the unit
   b. Rotate the DISCONNECT (ON/OFF) switch CLOCKWISE until the black arrow points to "OFF"

*Figure 5: Turning off the Rhino. Turn **CLOCKWISE ONLY***

b) Long Duration: If the unit will be stored for a long time, turn the DISCONNECT (ON/OFF) to the OFF Position
   i. If storing for a long period time, make sure that the front container ("frunk") is closed, and that all inlet/outlet receptable covers are installed to mitigate water ingress into the electrical outlets

Source: ONYX Power

5. Charging the Rhino

IMPORTANT: The Rhino will only charge when it is "ON". See Section 3.1 above for details.

The Rhino will take approximately 3-4 hours to fully charge if fully depleted.

a) From 110/120V: Plug in the charging cable into the inlet 110/120V port and the other end into an outlet. NOTE: The Rhino is supplied with a standard extension cord in the frunk that may be used for charging.

Figure 6: Connecting the Charging Cord

b) From solar: Connect the Rhino to solar panels as described in the next section. Ensure that the solar panels are oriented to receive maximum sunlight. See Section 6 below for details.

c) The unit may be charged simultaneously by both solar and 110/120V if desired.

d) The state of charge (SOC) of the Rhino can be monitored at any time directly from the SOC display on the unit, or via the VictronConnect phone app if your phone is within Bluetooth range of the unit.

6. Connecting and Charging the Rhino with Solar Panels

IMPORTANT: The Rhino will only charge when it is "ON". See Section 3.1 above for details.

a) The Rhino is supplied with a Solar Cable adaptor cable in the frunk. Connect the solar panel adaptor cables to the solar charging inlet as shown below.

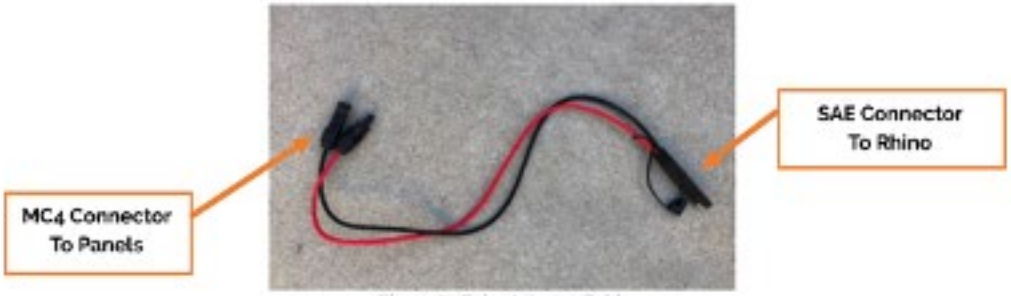

Figure 7: Solar Adaptor Cable

The Rhino contains an integrated solar MPPT and inverter. DO NOT ATTEMPT to connect solar panels to the Rhino that have already been wired to an independent solar inverter or MPPT.

Source: ONYX Power

b) Insert the connector into the solar input port firmly until fully engaged.

Figure 8: Connecting Solar Panels to the Rhino

c) To begin charging from solar, turn the Rhino DISCONNECT (ON/OFF) to the "ON" position as shown in Figure 4.

Source: ONYX Power

7. Connecting Rhinos in Parallel

To double or triple the duration that a single Rhino can power equipment, up to two (2) additional Rhinos may be connected in parallel to the primary unit.

IMPORTANT: When connecting Rhinos together the percentage state-of-charge (%SOC), also known as the charge level, must be within +/- 10% of the %SOC of the primary unit (the Battery Monitor will display %SOC). DO NOT attempt to charge a Rhino that has been depleted via the parallel port, this will void any applicable warranty. Recharging a Rhino should be performed via the 120V inlet plug or solar input.

a) Up to two Rhinos may be paralleled to the primary unit.

b) Make sure that the DISCONNECT (ON/OFF) switch is in the "OFF" position for all Rhinos that will be connected together. **Double check that the %SOC of all Rhinos to be connected are within +/- 10% SOC or each other.**

c) Each Rhino is supplied with a parallel connection cable in the frunk.

Figure 9: Rhino Parallel 'Booster' Cable

d) Open the caps on the parallel ports. Connect the ONYX Rhino parallel booster cable to the primary unit first, and then connect the other end to the supplemental Rhino. Use of any cable for this purpose other than one supplied by ONYX will void any applicable warranty.

Figure 10: Connecting the Parallel Cable

e) To begin using the primary Rhino, turn the Rhino DISCONNECT (ON/OFF) to the "ON" position as shown in Figure 4. The supplemental Rhinos can remain "OFF".

Source: ONYX Power

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APPENDIX C: Rhino Storage Procedure

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APPENDIX C:
Rhino Storage Procedure

ONYX

MORBUG Project: Rhino Storage Procedure

1. Transporting and Handling the Rhino

- CAUTION: The Rhino is VERY HEAVY (more than 300lbs) so please take great care while moving.
- CAUTION: Unless mobility is needed while the Rhino is running, make sure that the disconnect switch is in the OFF position before transporting.
- CAUTION: The Rhino should not be placed in standing water.
- CAUTION: Do not lay the unit face down on the side with the front container ("frunk" hatch) or on either side with the latches. The Rhino should remain upright or lay flat with the "frunk" facing upward.
- RECOMMEND: Use multiple people and appropriate lifting techniques / equipment such as hydraulic lift tables and lift gates when loading/unloading from vehicles.
- RECOMMEND: When inside vehicles, secure the Rhino to prevent movement during transport.
- RECOMMEND: Store all cables and accessories that were provided inside the front container ("frunk").

2. Turning Off / Storing the Rhino

a) Turn the Rhino "OFF" when not in use to save energy Keeping the Rhino "ON" will slowly drain energy by using standby power which will eventually cause the Rhino to drain to below 0% capacity. When the Rhino fully drains, it will make an audible alarm. If the Rhino is not turned off or recharged when this audible alarm sounds then a fault will occur if the Rhino continues to drain further. **This fault is only resettable via a service call from trained ONYX Power personnel and may void ONYX Power's warranty. Do not store the Rhino in the "ON" position.**

1. To turn the Rhino "OFF" locate the DISCONNECT (ON/OFF) switch on the side of the unit
2. Rotate the DISCONNECT (ON/OFF) switch CLOCKWISE until the black arrow points to "OFF"

*Figure 1: Turning off the Rhino. Turn **CLOCKWISE ONLY***

b) Long Duration: If the unit will be stored for a long time, turn the DISCONNECT (ON/OFF) CLOCKWISE to the OFF Position.

i. If storing for a long period time, make sure that the front container ("frunk") is closed, and that all inlet/outlet receptable covers are installed to mitigate water ingress into the electrical outlets.

Source: ONYX Power

ii. The Rhinos can be stored for several years without use and remain healthy, losing only about 2-3% of their stored energy each month. If storing for longer than a year, it is recommended to monitor the system voltage, either through the SOC Display or the Victron App, once per quarter to ensure the Rhino voltage does not dip below 50.4V. If the Rhino voltage dips below 50.4V, turn the Rhino ON and connect the Rhino to a charging source (AC, Solar, etc.) until the Rhino voltage is above at least 53V.

iii. The Rhino should be stored in a shaded and weather-protected area in the upright position

iv. Storage temperature range: -20-45˚C / -4 - 113˚F

3. Storing Spare Parts

If your Rhino was delivered with spare electrical parts (batteries, inverters, etc) the following provisions should be taken to maintain these parts in good, working order.

a) Store all spare parts indoors and elevated off of the floor

b) Keep spare parts in the supplied packaging

c) Spare batteries can be stored for several years without use and remain healthy. Within the recommended storage temperature, the batteries will lose less than 1% SoC per month and batteries are shipped at approximately ~30% SoC. It is recommend to test the voltage of the batteries every six months to ensure battery health (voltages above 50.2VDC indicate >20% SoC). ONYX recommends using an approved external charger if battery voltage registers below 49.5VDC.

d) Storage temperature range:: -20-45˚C / -4 - 113˚F

Source: ONYX Power

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APPENDIX D: Use Case Survey

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APPENDIX D:
Use Case Survey

ONYX Rhino Use Survey

1. Rhino unit serial #: _____ Used from ___/___/___ to ___/___/___

2. Rhino unit specific use

☐ Plugin house loads ☐ Transfer switch ☐ Remote location

3. Type of electrical loads powered

☐ Emergency Cooling/Heating ☐ Fridge ☐ Internet ☐ Lights

☐ Laptop/Tablet/Phone ☐ Medical equipment ☐ Recreational ☐ Fan

☐ Cooking ☐ TV ☐ Tools ☐ Pumps ☐ Other _____

4. Grid power outage occurred

☐ No ☐ Yes

5. Rhino unit charging source

☐ AC power outlet ☐ Solar PV ☐ AC power outlet + Solar PV

6. Rhino unit ease of set-up and use

☐ Easy ☐ Moderate ☐ Difficult

7. Rhino unit effectiveness

☐ Very useful ☐ Somewhat useful ☐ Not useful

8. Additional comments on Rhino use (Optional)

Issues/ Limitations:

Observations:

Feature requests/Recommendations:

Source: ONYX Power

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APPENDIX E: Instruction for Panther Setup and Connection to Rhino

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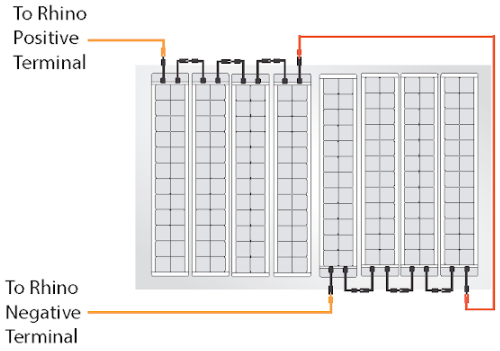
APPENDIX E:
Instruction for Panther Setup and Connection to Rhino

1 Solar Blanket

WIRING DIAGRAM

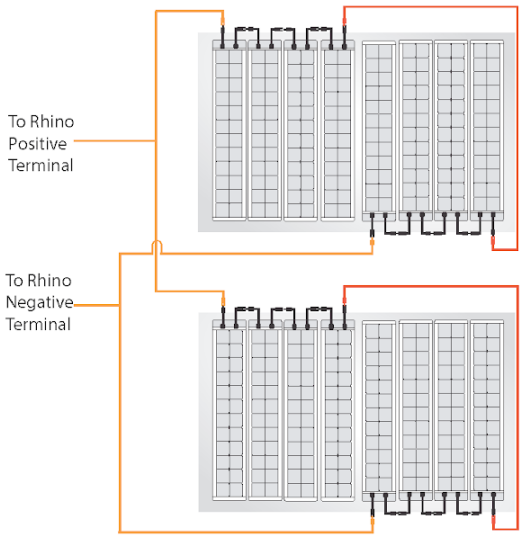


ELECTRICAL SPECS

MERLIN® PV Module Specs[1]	Unit	
Cell Type Mono		PERC
Rated Power (P Max)	W	1000
Voltage at Pmax (Vmp)	V	107.12
Current at Pmax (Imp)	A	8.59
Open Circuit Voltage (Voc)	V	127.52
Short Circuit Current (Isc)	A	9.21

2 Solar Blankets

WIRING DIAGRAM



ELECTRICAL SPECS

MERLIN® PV Module Specs[1]	Unit	
Cell Type Mono		PERC
Rated Power (P Max)	W	2,000
Voltage at Pmax (Vmp)	V	107.12
Current at Pmax (Imp)	A	17.18
Open Circuit Voltage (Voc)	V	127.52
Short Circuit Current (Isc)	A	18.42

Designed and Engineered in the USA

MERLIN SOLAR

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APPENDIX F: Rhino Transfer Switch Quick Guide

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APPENDIX F:
Rhino Transfer Switch Quick Guide

Source: ONYX Power