

# Culebra and Vieques Microgrid Technical Assistance Efforts



*PRESENTED BY*

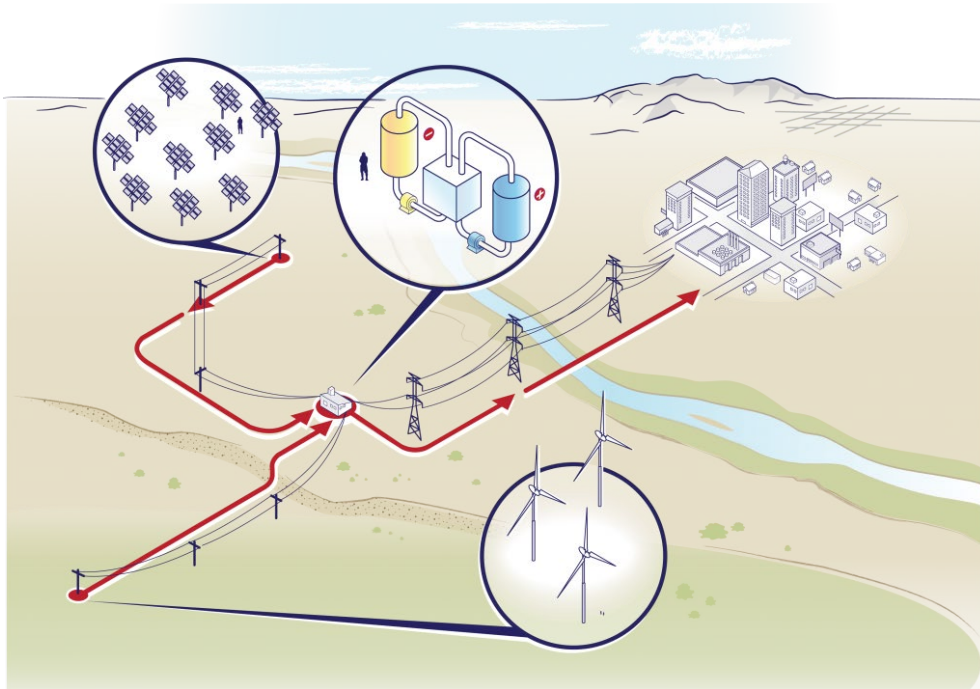
Brooke Garcia, Jimmy Quiroz, Matthew Lave

June 25<sup>th</sup> and 27<sup>th</sup>, 2024

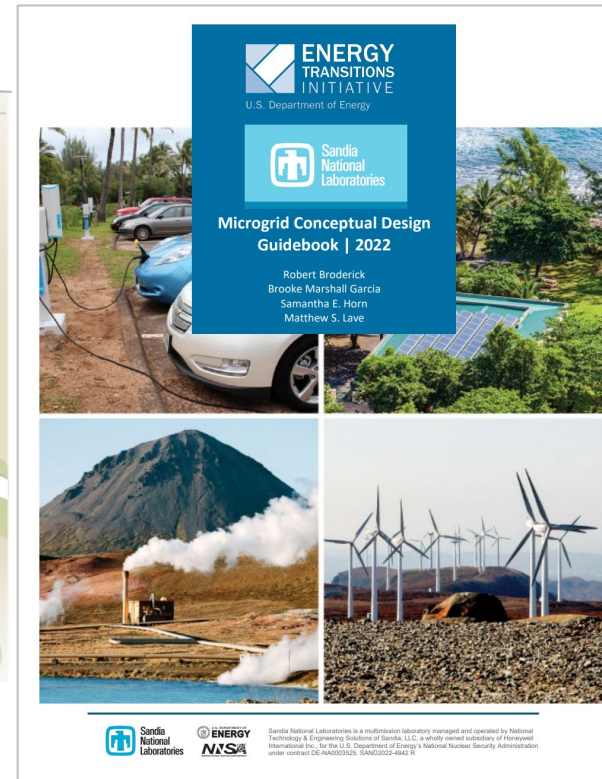
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# Sandia National Laboratories

Sandia National Labs - one of the U.S. Department of Energy's research laboratories - has a research and development department dedicated to evaluating and enabling advanced microgrids.



Taken from Sandia National Laboratories' Advance Microgrid website:  
<https://energy.sandia.gov/programs/electric-grid/advanced-microgrids/>



The Microgrid Conceptual Design Guidebook was published as part of Sandia's effort to enable communities in their energy transition goals.



# Culebra, 2021 Workshops to Now

As part of the DOE energy resilience projects, Sandia developed tools used for siting and roughly sizing/costing microgrids with a focus on **resilience metrics that quantify how well primary human needs are satisfied** during and after disruptions.



**Folleto 2: Definición de Microrredes**

Las configuraciones de microrredes modernas incluyen variabilidad en sus tecnologías. Cuando se diseñan correctamente (y se gestionan bien) para adaptarse a una amplia variedad de cargas, las microrredes pueden proporcionar energía y servicios confiables según las necesidades locales y de largo alcance de las acciones vigentes. Las microrredes pueden ser independientes o integradas, remotas o simples, y alimentadas por fuentes renovables o convencionales.

**Microrredes: Tamaños y Tipos**

Definimos una microrred como un grupo de equipos eléctricos interconectados (centralizados) que actúan como una única entidad con un modo de vida o controlado a la vez (incluido los reguladores). Las microrredes varían en su amplia variedad de tamaños. Los tipos de microrredes varían en su modo de operación y en el tipo de servicios asociados que se puede lograr.

Definición del sistema	Tamaño nominal	Actividad
Microrred	200kW a 20 MW	Residencial, Comercial, Industrial

**Folleto 4: Planificando Para Microrredes**

**Metas y objetivos para buscar soluciones de resiliencia energética**

Si el grupo está considerando implementar nuevas soluciones de energía y comenzar a diseñar estas soluciones energéticas, piense en las siguientes:

- ¿Cuáles son los principales riesgos por los que su grupo está considerando estas soluciones energéticas, de confiabilidad, ambiental y de otros tipos?

**Ejemplo de Métricas de Rendimiento**

Esas son métricas asociadas con resiliencia y seguridad de suministro. Premios otorgados en función de la resiliencia y el desempeño del sistema.

**Ejemplo de Métricas de Conectividad**

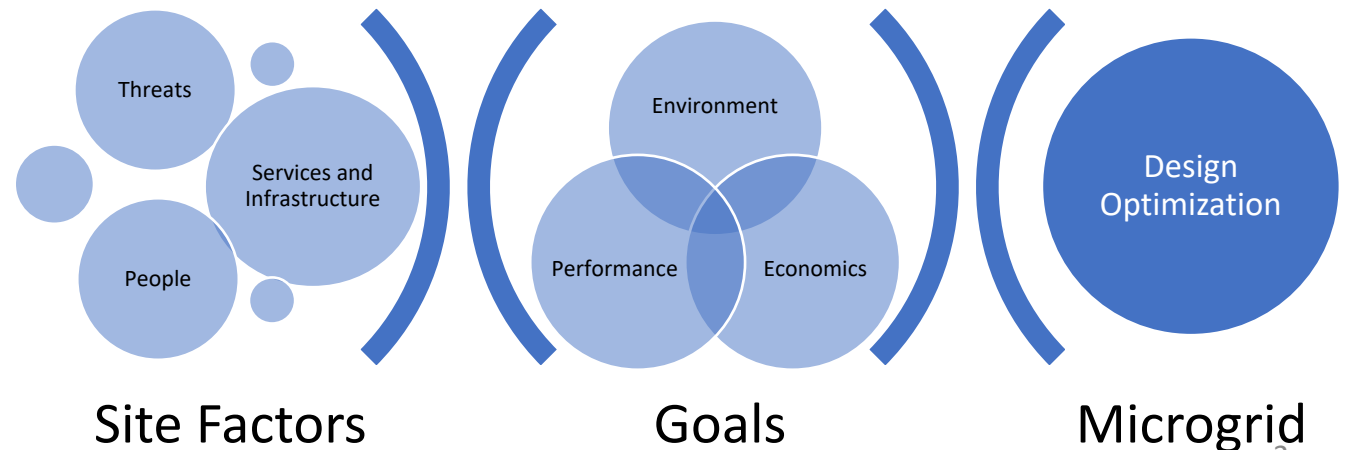
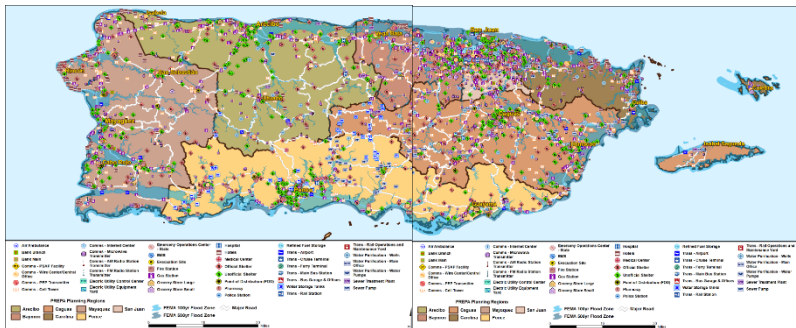
Esas son métricas asociadas con resiliencia y seguridad de suministro. Premios otorgados en función de la resiliencia y el desempeño del sistema.

**Ejemplo de Métricas de Resiliencia**

Esas son métricas asociadas con resiliencia y seguridad de suministro. Premios otorgados en función de la resiliencia y el desempeño del sistema.

**Ejemplo de Métricas de Sostenibilidad**

Esas son métricas asociadas con resiliencia y seguridad de suministro. Premios otorgados en función de la resiliencia y el desempeño del sistema.

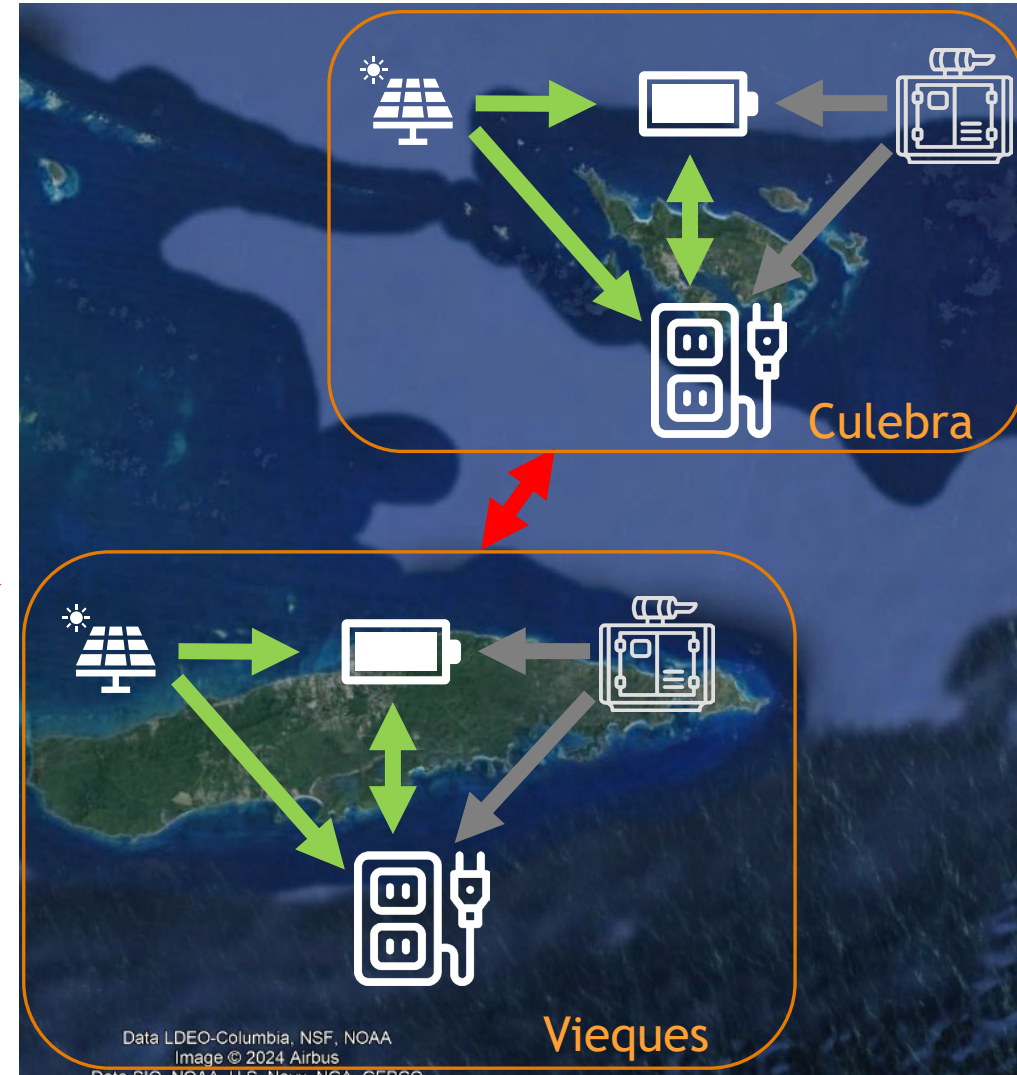
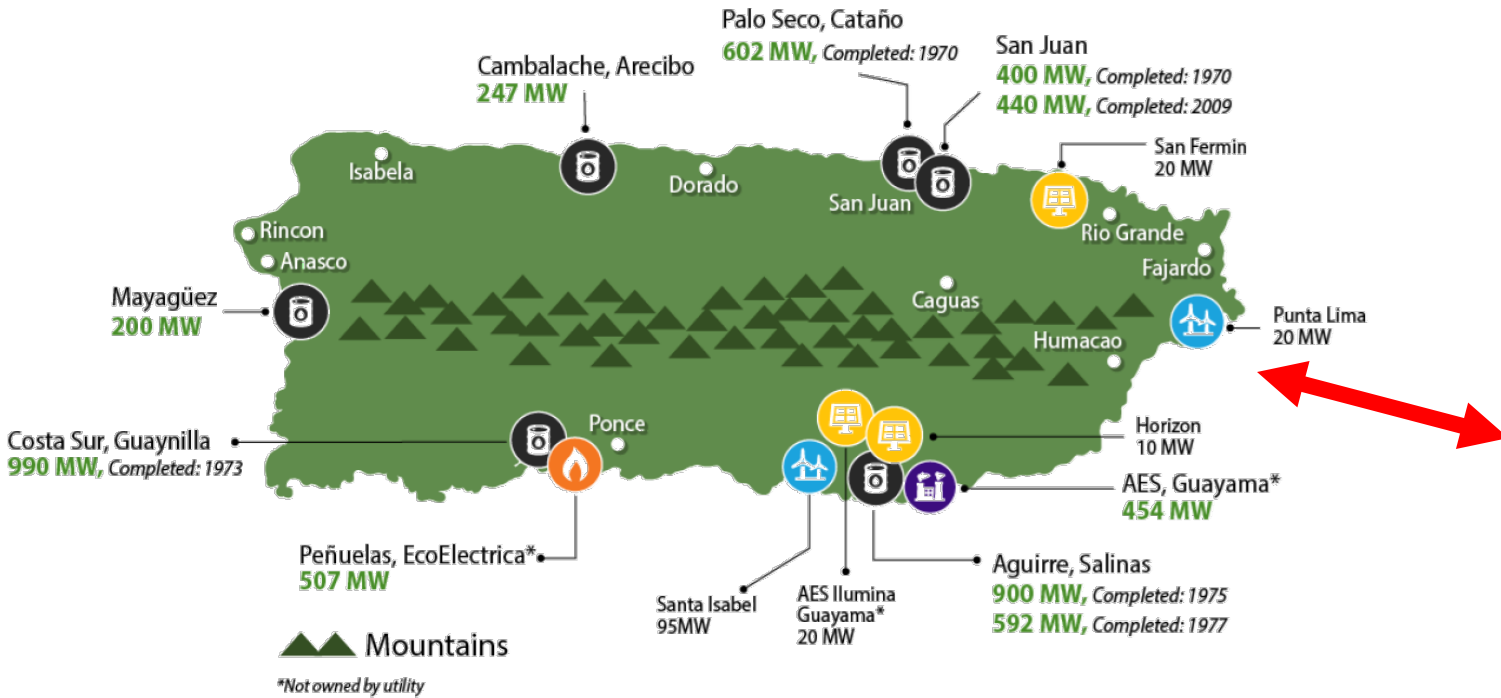


# Culebra & Vieques Microgrid Conceptual Layout



Culebra and Vieques microgrids can operate with or without connection to the main island generation. During typical conditions, power can flow to Vieques/Culebra or excess generation can flow back to the main island. In an emergency, Culebra and Vieques microgrids can operate independently or as one combined Vieques + Culebra microgrid.

- █ Links between islands
- █ Within-island connections, always on
- █ Used only in an emergency



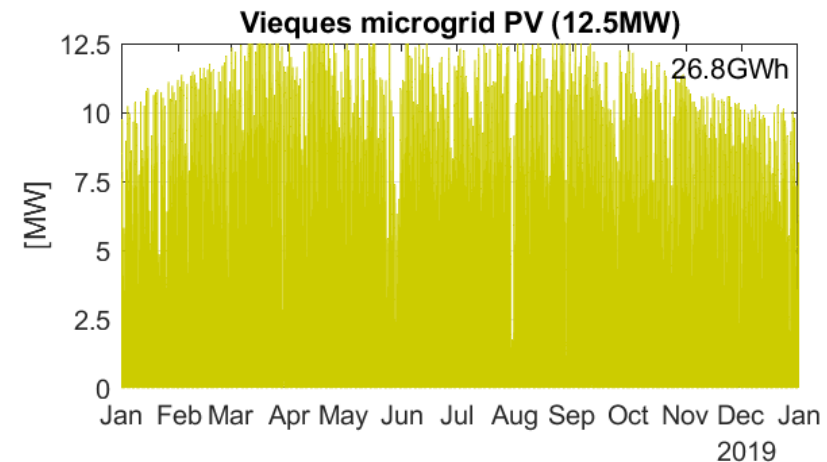
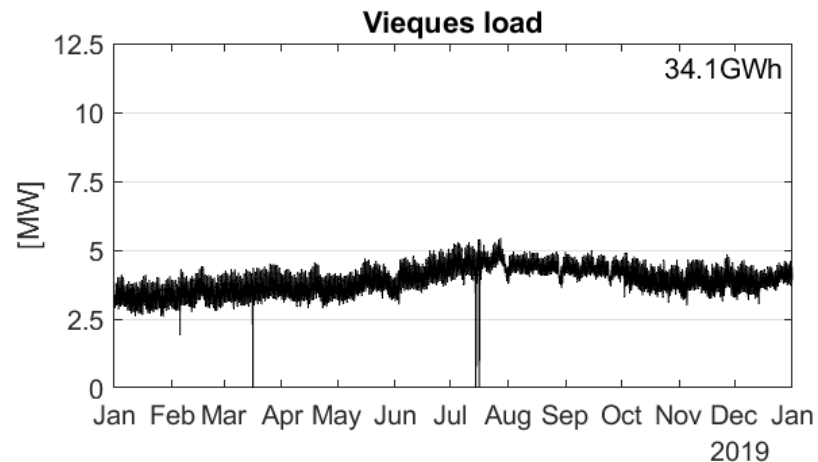
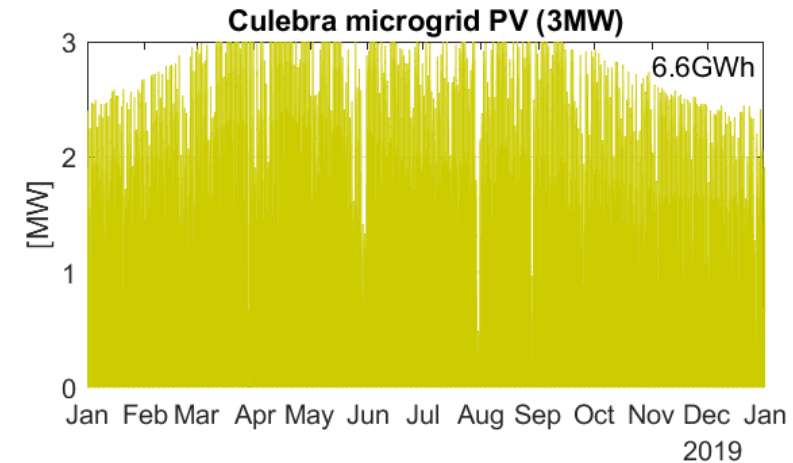
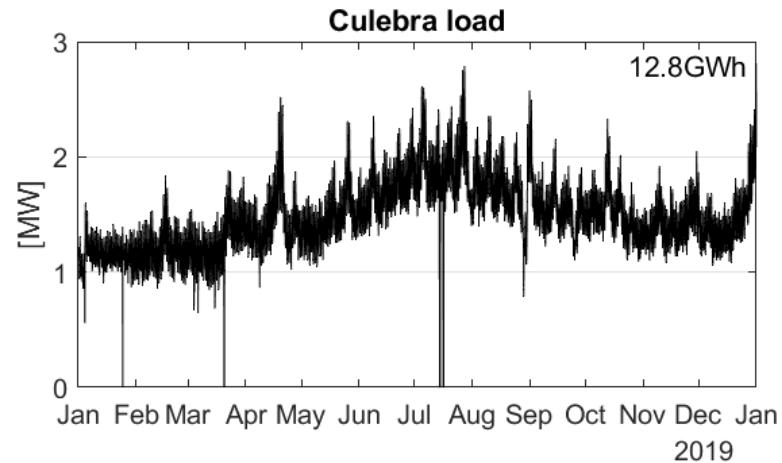
Generation cartoon map from NREL  
 Satellite map from Google Maps  
 Generator icon and electric socket icon from Flaticon.com

Data LDEO-Columbia, NSF, NOAA  
 Image © 2024 Airbus

# Load and Microgrid PV



Based on preliminary microgrid PV sizing\* of 3MW on Culebra and 12.5MW on Vieques, microgrid solar would produce a large amount of the total energy consumed on Culebra and Vieques. Solar power capacity is much larger than each island's peak power consumption because solar power is only produced during sunny daytime hours, so must be larger to match energy needs.

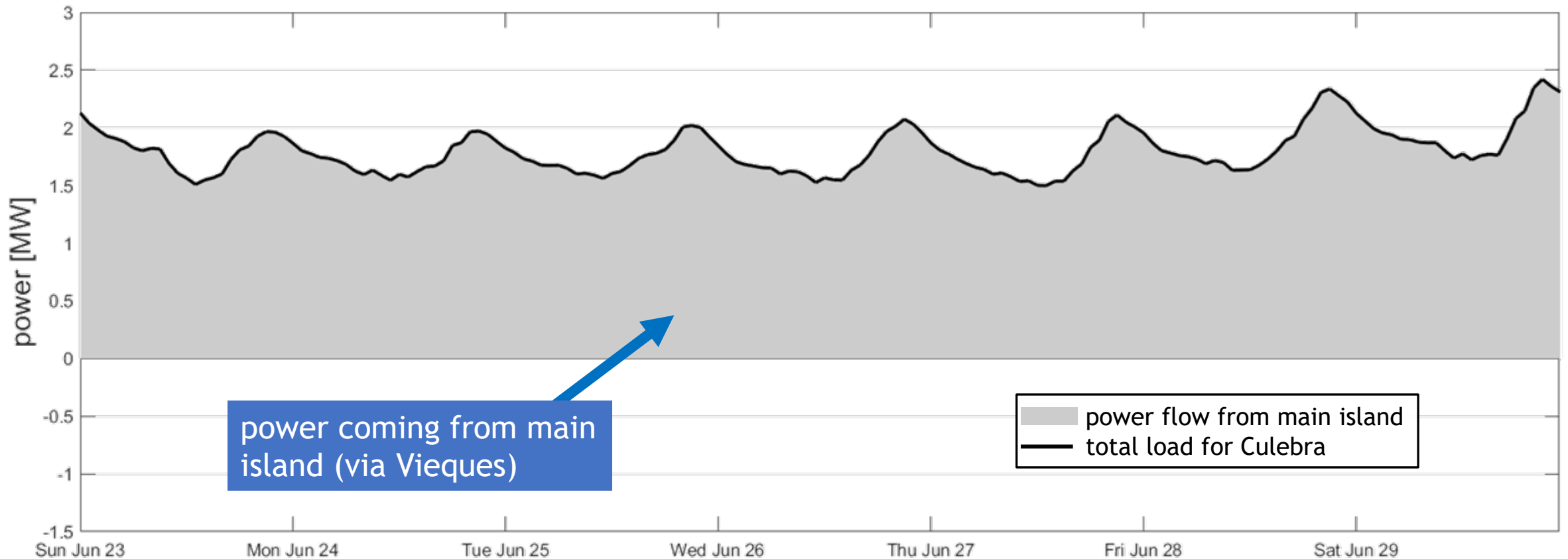


\*<https://www.fema.gov/press-release/20230329/biden-harris-administration-fema-approve-over-102-million-phase-1-solar>

# Typical Week



Today, almost all power comes from generators on the main island.

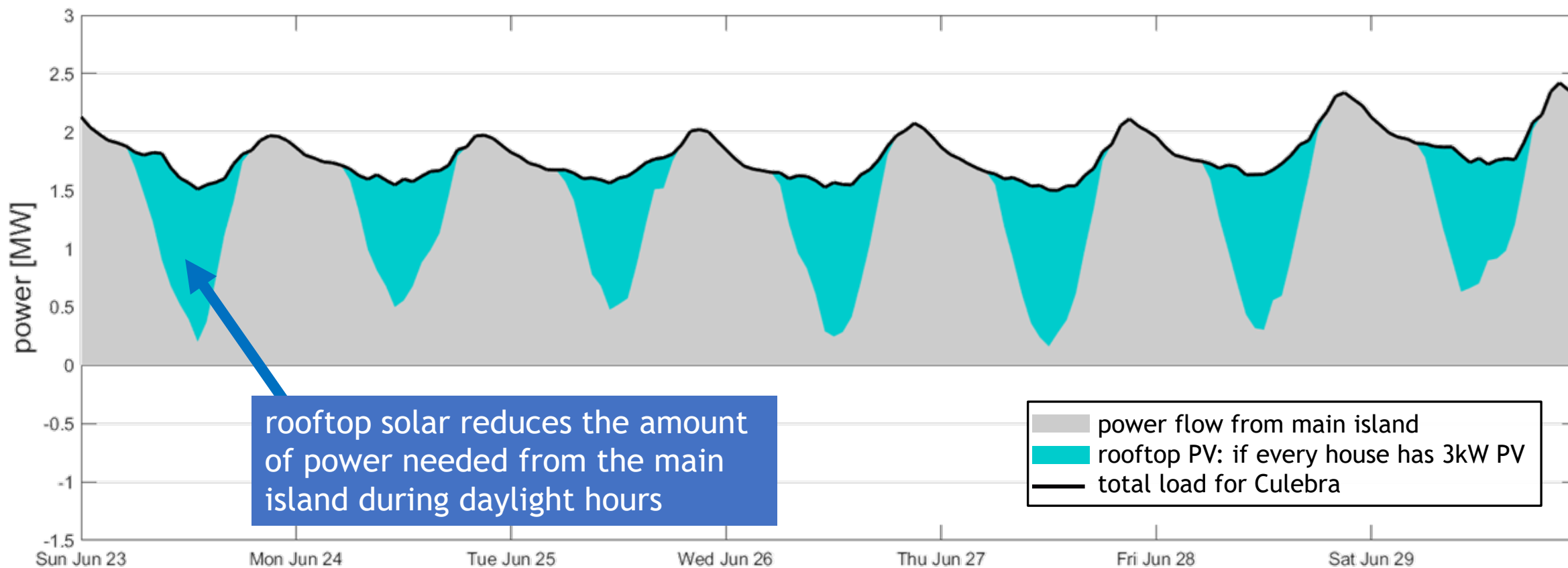




# Typical Week with Rooftop Solar



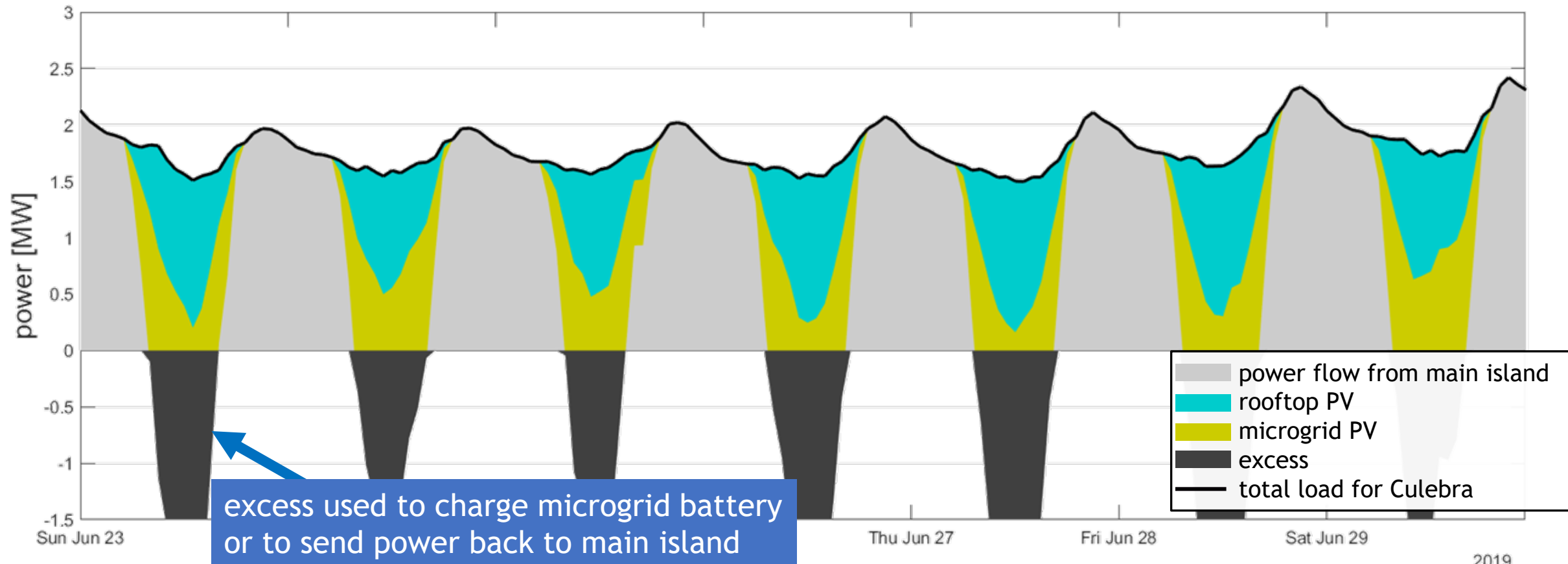
As the amount of rooftop solar increases, the amount of power drawn from the main island during the day will decrease.



# Typical Week with Microgrid Solar



With the microgrid setup, excess solar power generated on Culebra will be used to charge the microgrid battery or will feed “backwards” to power loads on Vieques and/or the main island.



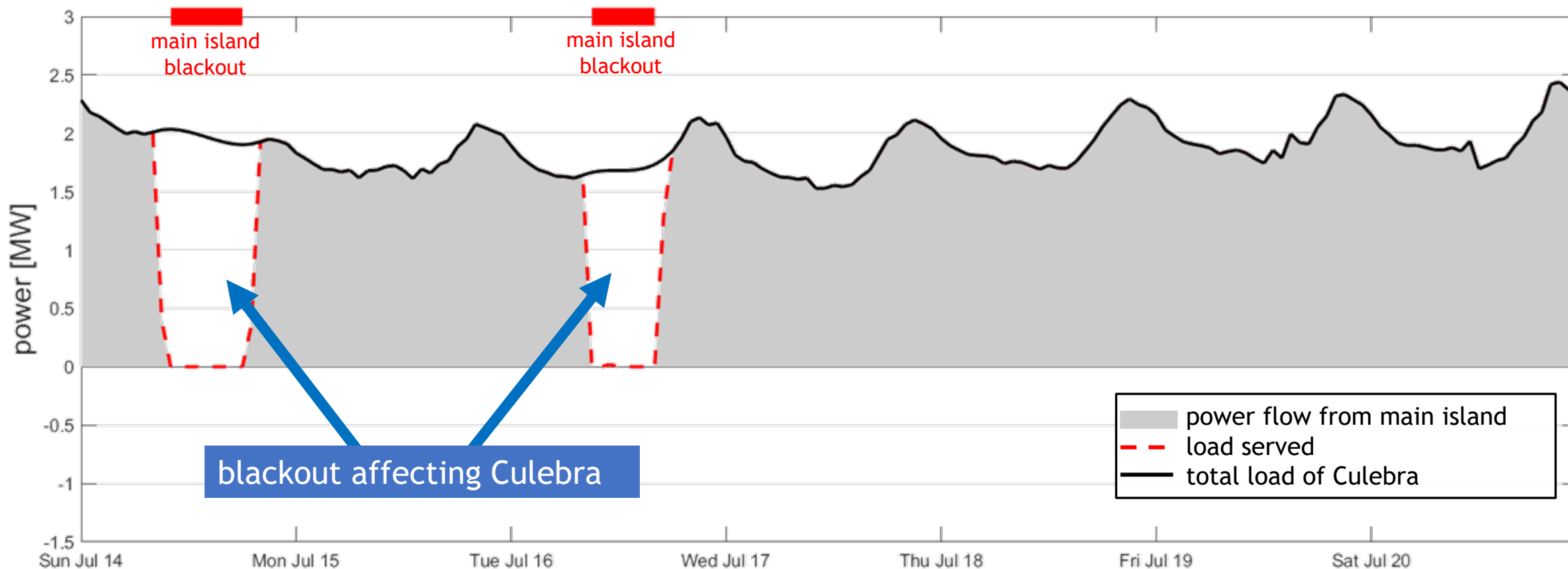


# Week with Blackout: no Microgrid



Without a microgrid, when the main island experiences a blackout so will Culebra.

Rooftop solar systems with batteries may be able to keep powering specific homes for as long as the battery lasts, but any buildings without solar + battery systems will lose power.

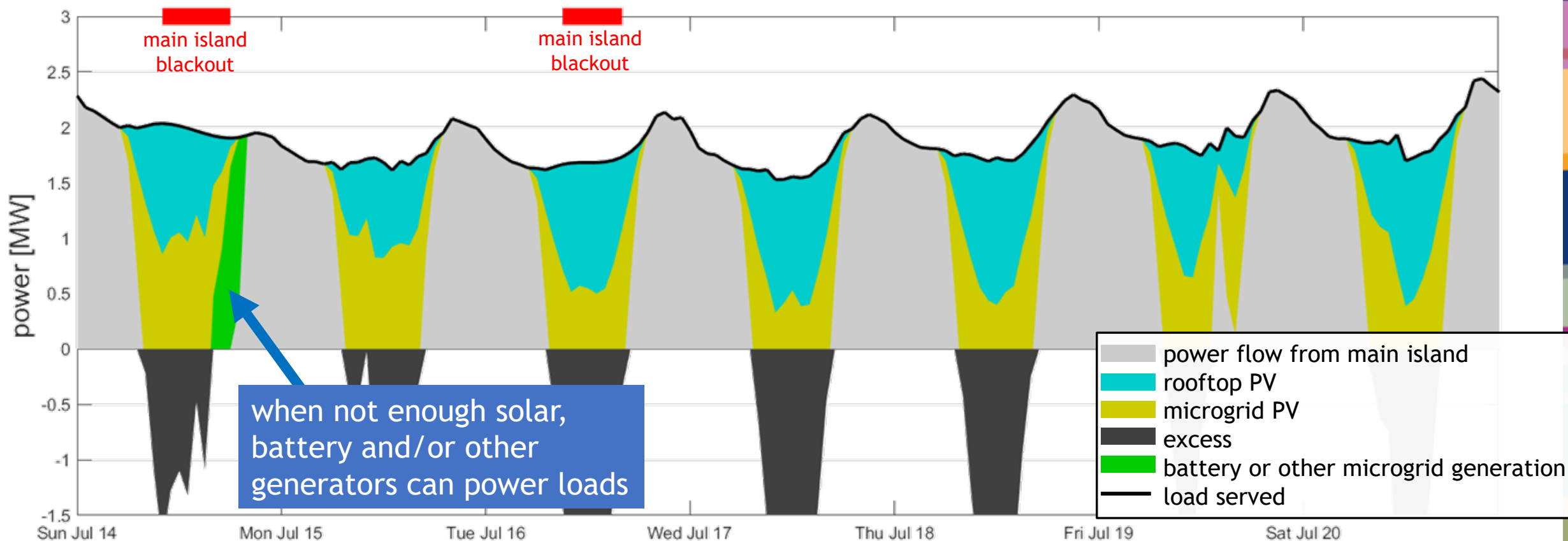


# Week with Blackout: Microgrid Operates Islanded



With the microgrid setup, Culebra can remain powered even when there is a blackout on the main island.

When available, solar generation will power loads on Culebra. When solar power is not enough, batteries and/or other generation that is part of the microgrid will be utilized.



# Long-Duration Blackout: Microgrid Operation



If Hurricane Dorian had caused a long -duration blackout, the microgrid could have supplied power to Culebra.

For a few hours, perhaps up to a few days, the microgrid solar plus battery system could power Culebra. For a longer blackout, additional generation on the microgrid will be necessary.

