

Celebrating 15 Years of State Leadership



Energy Storage Technology Advancement Partnership
(ESTAP) Webinar:

Energy Storage for Puerto Rico: Modular Solutions for Disaster Recovery

December 12, 2017

Hosted by Todd Olinsky-Paul
ESTAP Project Director
Clean Energy States Alliance

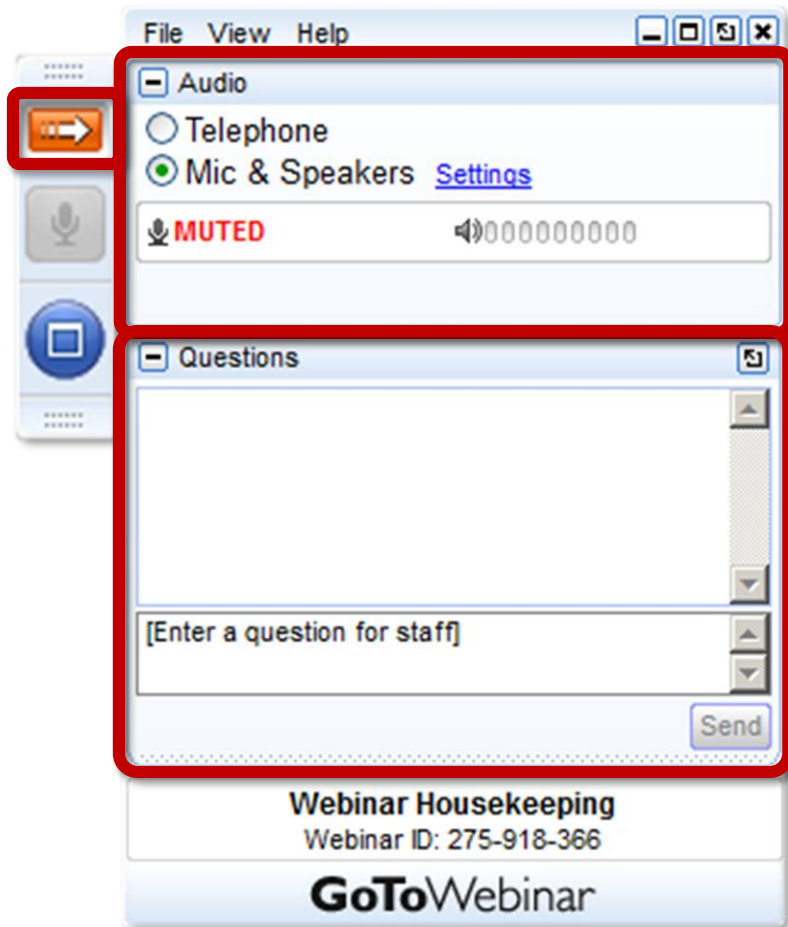


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Use the red arrow to open and close your control panel

Join audio:

- Choose Mic & Speakers to use VoIP
- Choose Telephone and dial using the information provided

Submit questions and comments via the Questions panel

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Celebrating 15 Years of State Leadership



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Department of Commerce
Innovation is in our nature.



Office of the People's Counsel
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Energy Storage Technology Advancement Partnership (ESTAP)

ESTAP is supported by the U.S. Department of Energy Office of Electricity and Sandia National Laboratories, and is managed by CESA.

ESTAP key activities:

- 1) Disseminate information to stakeholders through:
 - The ESTAP listserv (>4,000 members)
 - Webinars, conferences, information updates, surveys
- 2) Facilitate public/private partnerships at the state level to support energy storage demonstration project development.
- 3) Support state energy storage efforts with technical, policy and program assistance

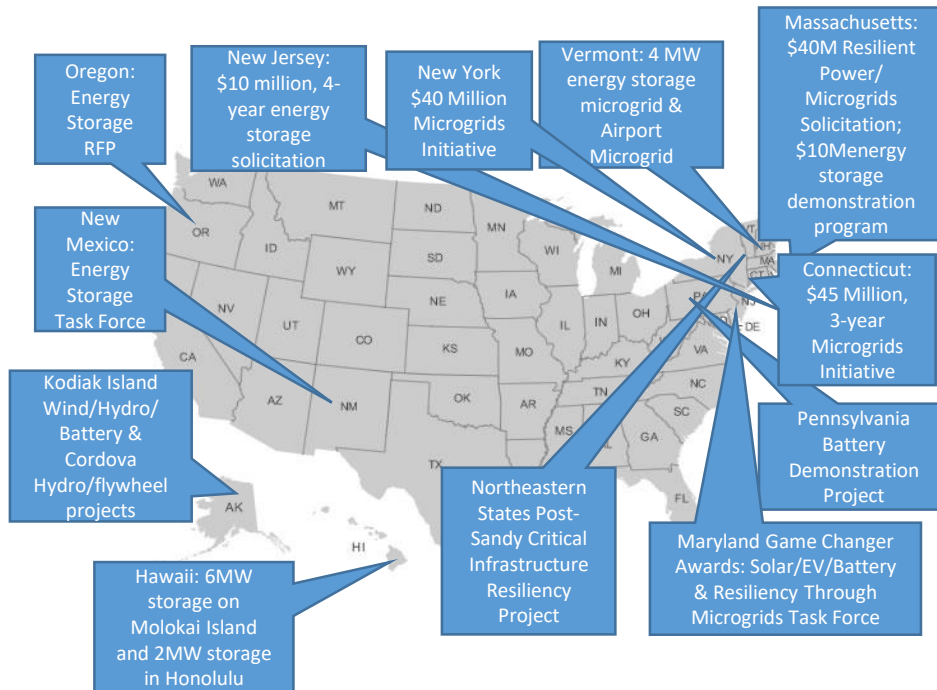
Thank You:

Dr. Imre Gyuk

U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability

Dan Borneo

Sandia National Laboratories



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www.cesa.org/projects/energy-storage-technology-advancement-partnership

About this Webinar Series

Comments from Dan Borneo, Sandia National Laboratories

- These webinars are intended to provide food for thought and to get the conversation started.
- Whatever we do in the short term should be able to be included in the long term solutions.
- Industry involvement is very important to provide ideas and implement solutions given the fast track nature of repairs needed.
- We are open to suggestions as to how the webinar series can help, and any other ideas about ways to help.



Panelists

- **Eric Gallant**, Director of Business Development, GS Battery
- **Cris Manickam-Shirley**, Energy Storage Market Manager, CivicSolar
- **Ian Munn**, Operations Manager, Solar Foundation
- **D. Ofelia Mangel**, Project Manager and Volunteer Coordinator, Resilient Power Puerto Rico
- **Todd Olinsky-Paul**, Project Director, Clean Energy States Alliance (Moderator)



Energy Storage for Puerto Rico: Modular Solutions for Disaster Recovery

ENERGY STORAGE TECHNOLOGY ADVANCEMENT PARTNERSHIP (ESTAP) WEBINAR

AGENDA



- Value of Energy Storage
- First Steps - RESCU
- Case Study 1: St Croix Commercial/Industrial Off-Grid
- Case Study 2: Haiti Lumiere Hospital
- Case Study 3: Ecuador Off-Grid

Value of Energy Storage



- **Increased integration of renewables**
 - Allows PV self consumption
- **Energy Resiliency / Energy Security**
 - Ability to operate islanded from grid
 - Battery backup/UPS function
 - Reduction in need for grid based energy services up to completely “off grid”
- **Increased Demand Side Energy Management Opportunities**
 - Reduced OpEx for energy procurement
 - Peak Demand Reduction
 - Time of Use Shifting
 - Reduced impact of energy price fluctuations

First Steps

- **RESCU Microgrid (Ruggedized Energy Storage Containment Unit)**
 - **Developed in collaboration with:**
 - U.S. Department of Energy Office of Electricity
 - Sandia National Laboratories
 - Fort Devens- Base Camp Integration Laboratory
 - MIT - Lincoln Laboratory
 - Hanscom AFB – Microgrid Test Bed
 - **Developed for Forward Operating Bases**
 - **Design Objectives:**
 - Reduction in diesel fuel consumption rates
 - Integration of PV into FOB microgrid
 - Improved microgrid reliability
 - Reduced maintenance costs
 - Reduced noise and heat signature



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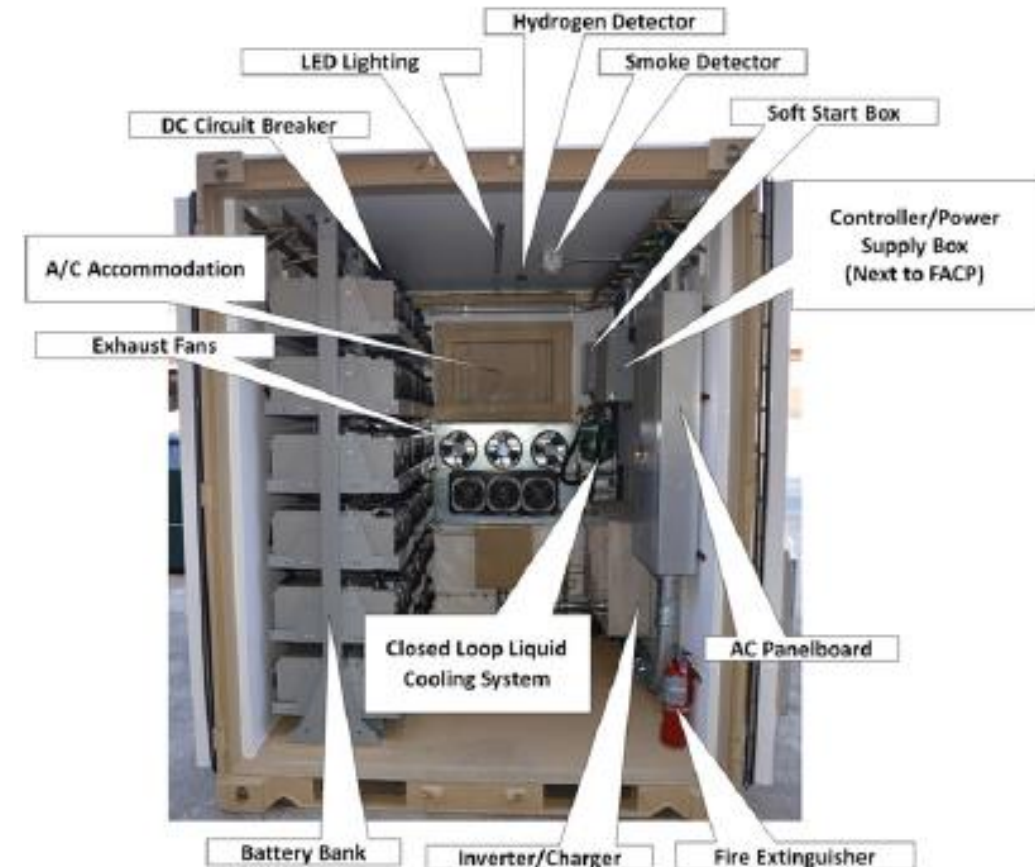
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First Steps

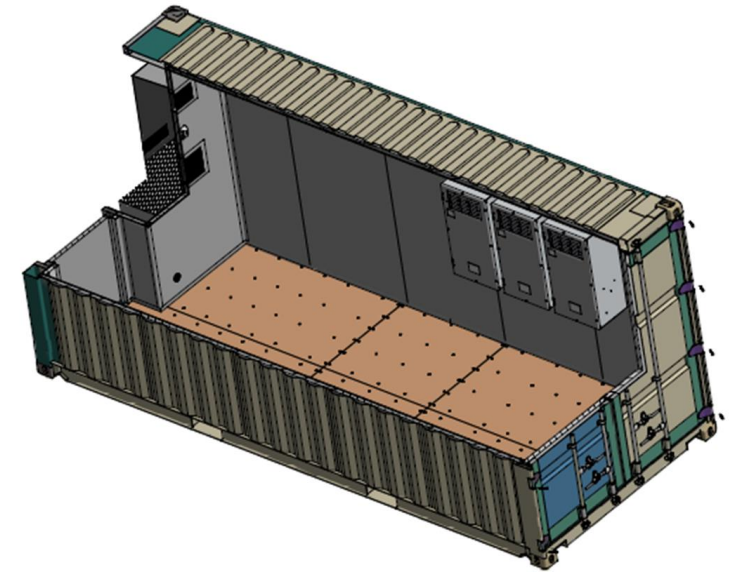
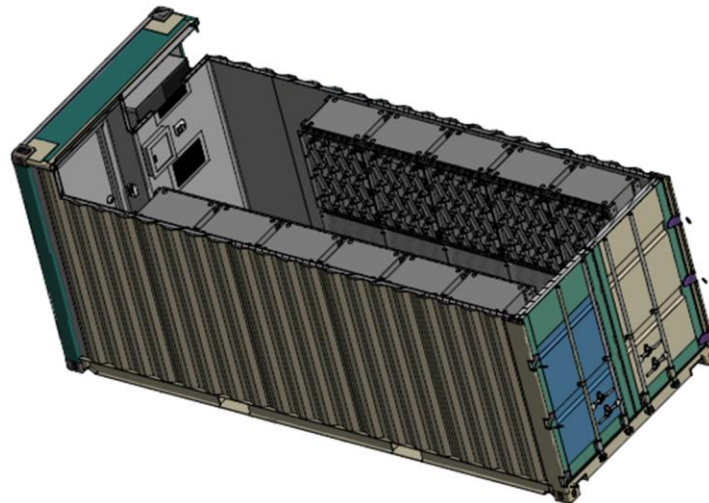
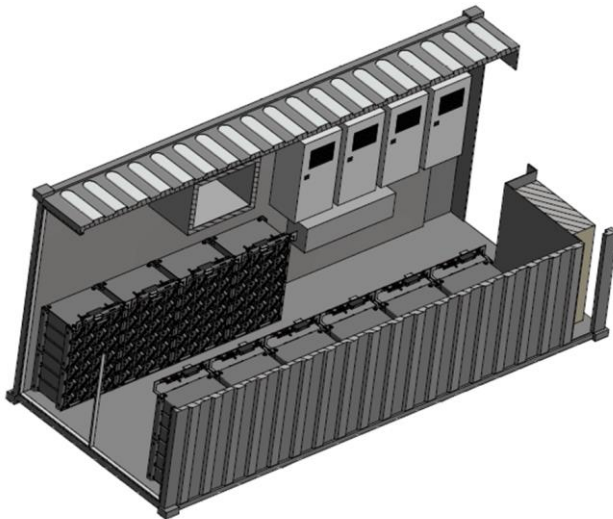
Technical Specifications:

- Tricon Container Format
- 108kWh of Energy Storage (Lead-Acid)
- 250kw bi-directional, multiport inverter
- 4.8kw roof top solar
- Energy Scavenging (DC coupled)
- Black start capable
- Integrated Generator Start/Stop Controls
- Ancillary Systems
 - Safety Features
 - Climate Control
 - H2 detection
 - Fire detection
 - Fire Suppression
 - Lighting



Next Steps

- **RESCU for Commercial Applications**
 - 120kW/240kWh version (20' Container)
 - 528kWh Energy Module (20' Container) Modular/Scalable
 - 90kW Power Module (20' Container) Modular/Scalable



Case Study 1: St Croix Cinema Off-Grid



- Case Study 1: St. Croix, USVI
 - Energy costs are very high throughout the Caribbean (~\$0.39/kWh)
 - Utilities run almost exclusively on fossil fuels leading to:
 - Utility price volatility
 - Air quality concerns
 - Utilities often lack “extra” generating capacity for new development
 - Community very sensitive to environmental concerns including:
 - Carbon footprint
 - Recyclability

COMMERCIAL

- ALL KWH -

■ Maintenance Surcharge



Commercial Energy Charge:	\$ 0.215218
Fuel Charge:	\$ 0.143603
Line Loss Surcharge:	\$ 0.002196
Pilot Surcharge:	\$ 0.000686
Self-Insurance Surcharge:	\$ 0.001925
Maintenance Surcharge:	\$ 0.024863

Total Commercial Charge:

\$ 0.388491 / kWh

Case Study 1: St. Croix Cinema Off-Grid



- Project Objectives:
 - Movie Theatre/Cinema
 - Complete off-grid operation
 - Reliably operate commercial/cinema loads including:
 - Extensive HVAC
 - Lighting
 - Sensitive projectors and IT loads
 - “Green” solution in keeping with Caribbean environmental concerns
 - Minimize hours on generator backup
 - Locally Maintainable
 - Low OpEx



Case Study 1:

St. Croix Cinema Off-Grid



- Energy Storage Technical Approach:
 - 336kWh of Energy Storage
 - Daily discharge cycles
 - 100% recyclable battery chemistry
 - Maintenance Free
 - 10 year warranty 15 year design
 - Medium voltage (300-500vdc) DC bus
 - Cell level battery monitoring
 - Voltage
 - Temperature
 - Current
 - SOH/SOC
 - Online Data Storage and Trending



Case Study 1:

St. Croix Cinema Off-Grid

- Post Hurricane Maria
 - Damage sustained to the PV system
- Was able to continue operation of the battery plus generator side to reduce fuel costs
- Currently shipping out panels to replace the damaged PV
- Planning on expanding the GS Battery system for further reliability



Case Study 2:

Haiti Lumière Hospital

- Case Study 2:
 - Remote location in the mountains of Southern Haiti
 - a 120 bed medical-surgical facility that served the 60,000 residences of Bonne Fin
 - no access to utility power
 - Relied on a combo of hydro and diesel generators often having regular brown and black outs that interrupted medical care, damaged sensitive equipment, and jeopardized medicine storage.



Case Study 2:

Haiti Lumière Hospital



- System Stats:
 - Solar: 84 kW
 - Inverters: AC Coupled SMA System
 - Storage: 192 kWh of GS SLR Batteries
 - Daily discharge cycles
 - 100% recyclable battery chemistry
 - Maintenance Free
 - 10 year warranty 15 year design
- Weathered Hurricane Matthew and had patients from 3 other major hospitals transferred to this facility



Case Study 3:

Ecuador Environmental Benefit

- Kapawi Lodge, Ecuador
 - Eco-lodge located in Amazon Rain Forest
 - Dependent on fossil-fuel generator for power generation
 - Generator noise and emissions had negative effects on delicate ecosystems including:
 - Noise Pollution
 - Air Pollution
 - Water Pollution
 - High OpEx related to generator fuel and maintenance.



Case Study 3:

Ecuador Environmental Benefit

- Project Objectives:
 - Reduction of fossil fuel consumption
 - Renewable integration
 - Improve site power quality and resiliency
 - Improved Power Quality
 - Improved customer experience
 - Decreased impact on sensitive ecosystems
 - Project reduced OpEx associated with generator fuel and maintenance
 - Reduction in diesel fuel consumption and related emissions



Case Study 3: Ecuador Environmental Benefit

- Energy Storage Technical Approach:
 - 48kWh of Energy Storage
 - Daily charge/discharge cycles
 - Self consumption mode
 - UPS function for loss of mains
 - Low voltage (48vdc) DC bus



QUESTIONS and COMMENTS



Contact Us:

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SOLAR SAVES LIVES



SOLAR SAVES LIVES

We have partnered with 4 humanitarian groups – Operation Blessing, Direct Relief, Clinton Foundation, and JP/HRO

We have other partners who are actively advocating for our initiative to their respective networks. These partners are helping connect us with product donations and fundraisers.



SOLAR SAVES LIVES

MEDICAL CLINICS:

60+ Identified // 10 Priority Clinics

All clinics we are working with are non-profits and have remained open before, during and after Irma and Maria. Many independent providers or IPA's did not remain. Thus, it is important to understand that the primary care network IS part of the critical infrastructure of PR and that their resilience is necessary.

Partnership with New Energy: Visiting these clinics and helping with the system designs. We have other volunteers supporting.

Greatest Need = Refrigeration

Critical Loads

SOLAR SAVES LIVES

MARKETS:

We have identified 2 large markets, the largest being Rio Piedras (1.5 MW) which President Bill Clinton visited just a few weeks ago and is our highest priority. The other market is Santurce 300 KW.

These markets provide food to the lower/middle class and are a place of business for many. We desperately need commercial size storage, as both must operate off-grid. We are planning to bring these online with as much of a capacity as possible. To lighten the load, our partners are exploring to use of more efficient appliances to make reductions at these sites.



Project Steps:

- Replace all lights, including spotlights in roof to LED to achieve a 10% reduction in consumption
- Replace two HVAC units with modern handlers to achieve a 30% reduction in consumption
- Redo roofing work to improve heat insulation to the site
- Install PV array

System Sizing info

Average Monthly Power Demand	345,000 kWh
30% savings with HVAC replacement	241,500
10% Savings with LED	207,000
Average Daily Power Demand	6,900 kWh
Average Daily Sunlight Hours	5 hr
Solar Array required for 100% offset	1,380 kW

Available Roof Space System Size	1,334 kW
Total Demand Offset	97%

* Final System Size may vary depending on PV Wattage Choice

Battery Storage Size	2,000 kW
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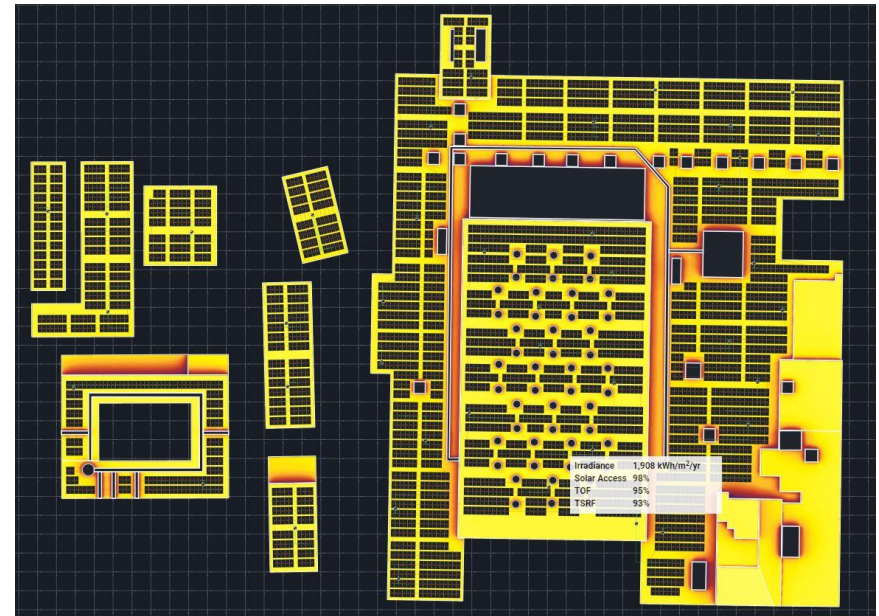
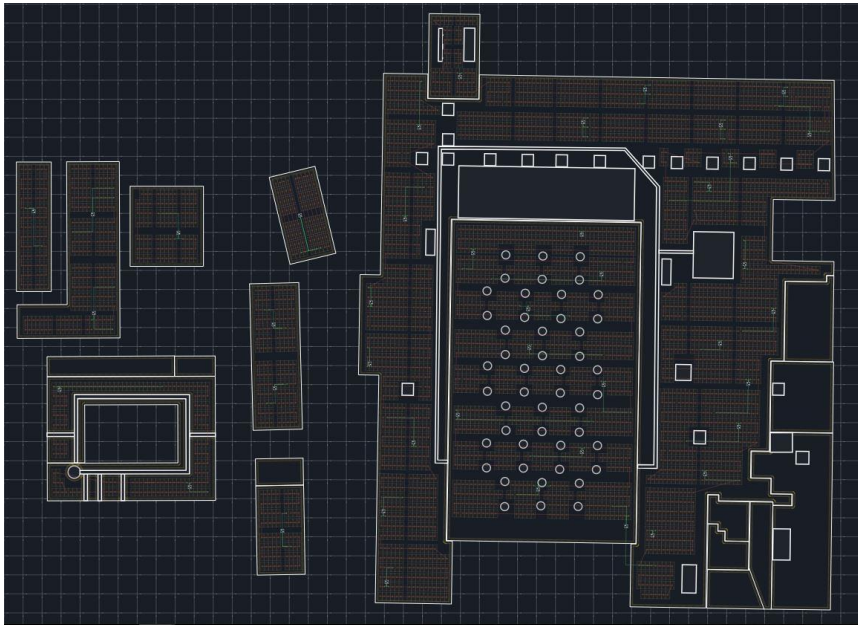
Procurement Wish List

Equipment Type	Model	Amount
PV Modules	LG 375W Poly Panels or equivalent	3548
DC Optimizers	Solar Edge P600	3548
Inverters	Solar Edge SE33K	40
Racking	Unirack or equivalent for flat concrete roof	1348kW
Battery Pack	Tesla Power Pack 2,000kW	1
HVAC	To be provided	2
LED Lights	To be provided	n/a
BOS	To be purchased locally	n/a
Design an Permit	Provided by New Energy	n/a
Installation	Prived by New Energy	n/a

Plaza del Mercado – Rio Piedras



Plaza del Mercado – Rio Piedras



SOLAR SAVES LIVES

COMMITMENTS & CHALLENGES:

Product Update

Foundations

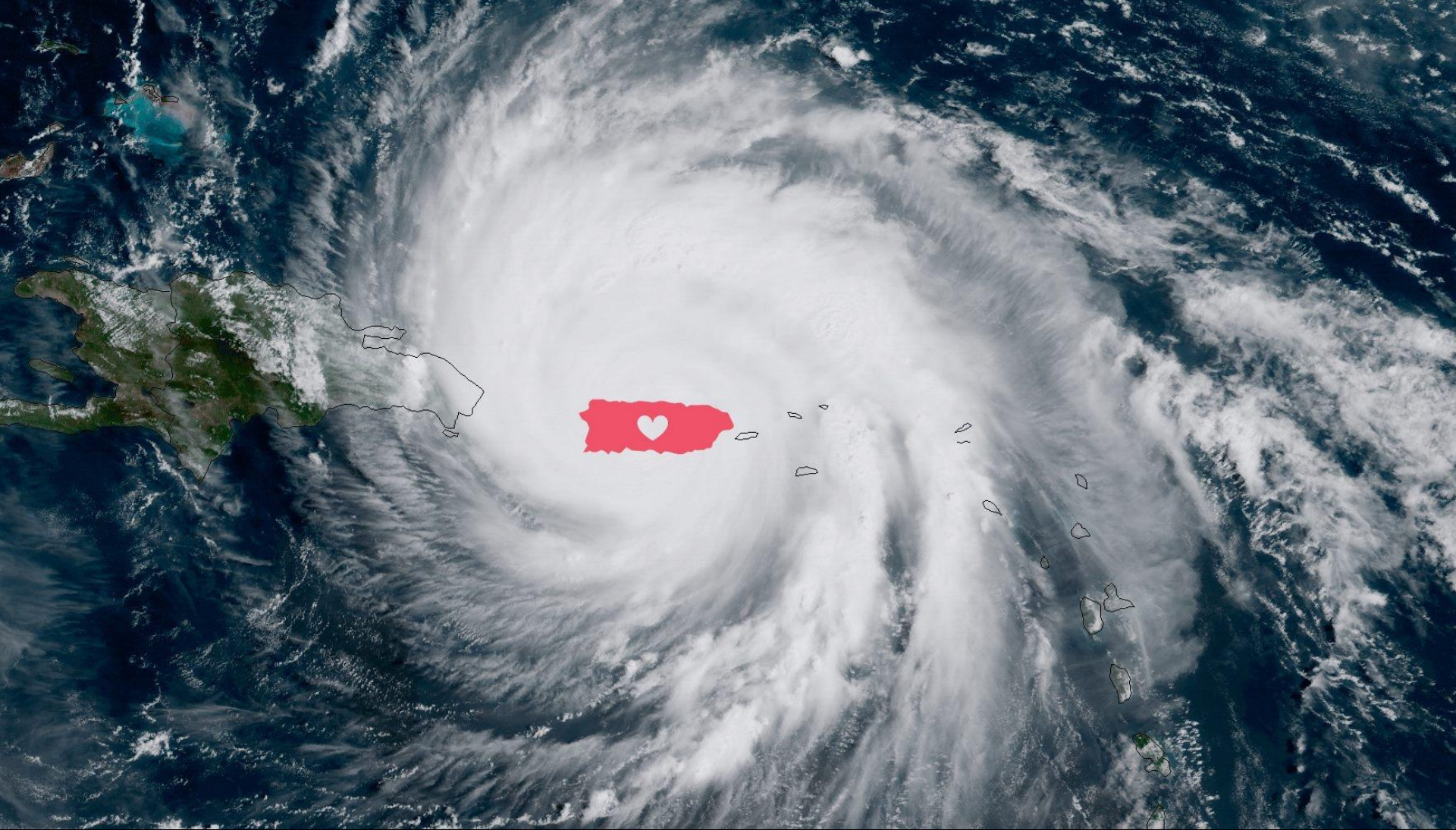
Financing of these projects?

Storage

- We have partners helping us make connections to manufacturers and assisting with outreach, but currently, this is still a large gap.

Monetary Donations

- This will help us to cover the necessary equipment purchases for the clinic sites and shipping



RESILIENT POWER PUERTO RICO

A project of the Coastal Marine Resource Center

ResilientPowerPR.org

staff@thecmrc.org



Lowest cost ever for off-grid solar

<\$2 per watt (humanitarian manufacturing at-cost)

Phase **1 | Triage Power** for community hubs, small 2 kW Solar Generators, \$3k per site

Phase **2 | Renewable Economy** funds local solar installation of 100 centers in 100 days, 30 kWh, \$40k

Phase **3 | Town Microgrids** sponsor installation by local companies, 10 MWh, \$15m

BENEFIT

REBUILD

for RESILIENT POWER PUERTO RICO
Saturday, Dec. 2
Rockaway Brewing Co. at the Beach
415 Beach 72nd St, Rockaway

PUERTO RICO

The Supertones
Patsy Carroll
Simon Chardiet
Alix & the Mechanics

\$5 donation; Music at 8pm resilientpowerPR.org

\$1.1 Million raised to date
in combined monetary and
solar material donation.

Cultural events such as the
Rockaway concert have made the
most contribution.

Other fundraiser events include
PTA's, Public Schools, Art Gallery
Shows, Dance Parties, Yoga
Retreats, and Birthdays.



Institutional Partners include:

Hispanic Federation

Rockefeller Family Fund

Kaplan Fund

Acacia Network

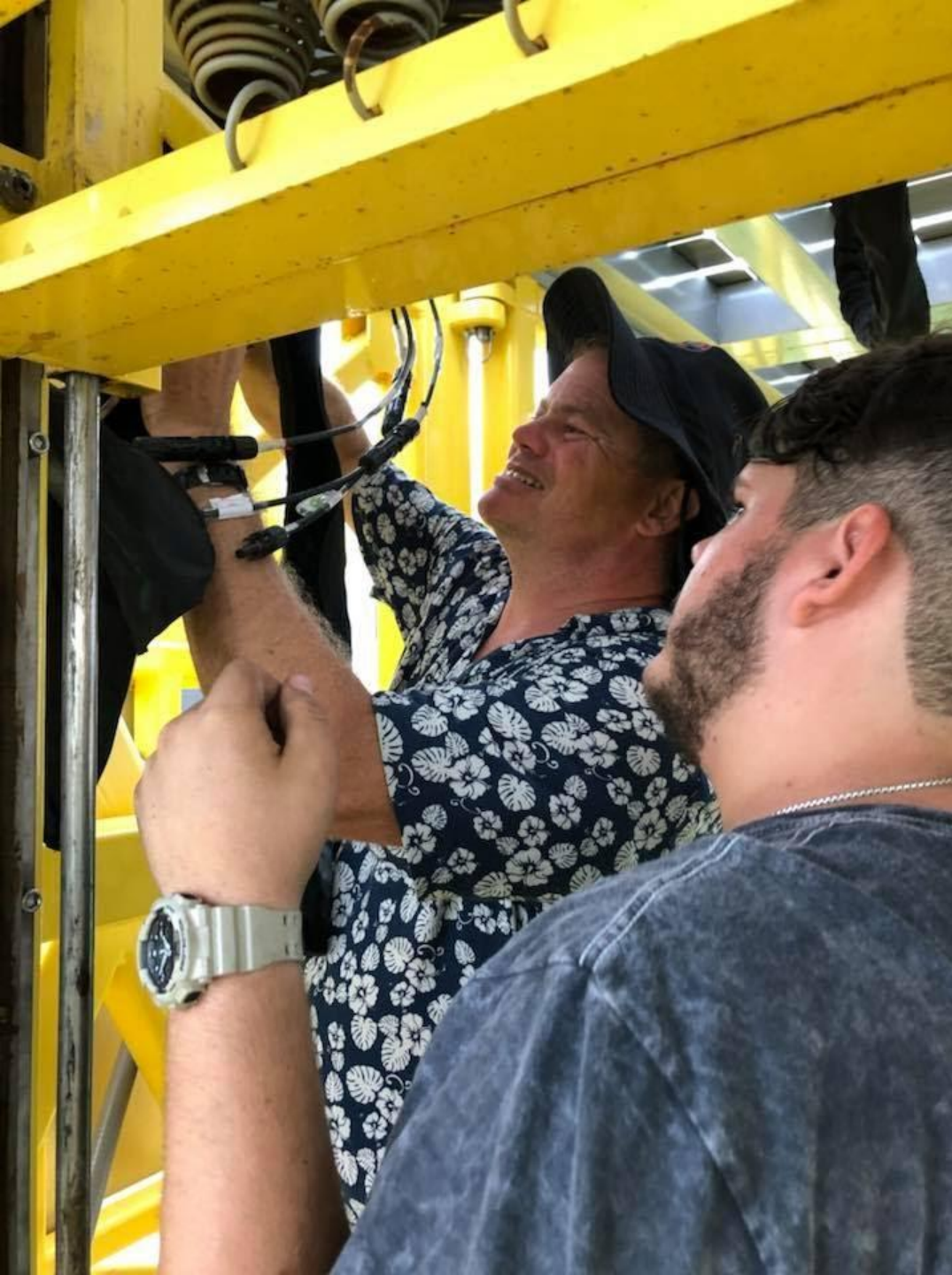
Rockefeller Center

The Spence School

The New School University

L&M Development Partners





Robert Wylie Hyde

Rockaway Resident
Solar Tech Educator

Leading a **Solar Salon** where volunteer University of PR students learn solar tech while helping install solar generators.

Future green job placement opportunities in phase 2 | renewable economy.



ISABELA HOSPITAL
Solar Salon installation with students and professors
from the University of Puerto Rico



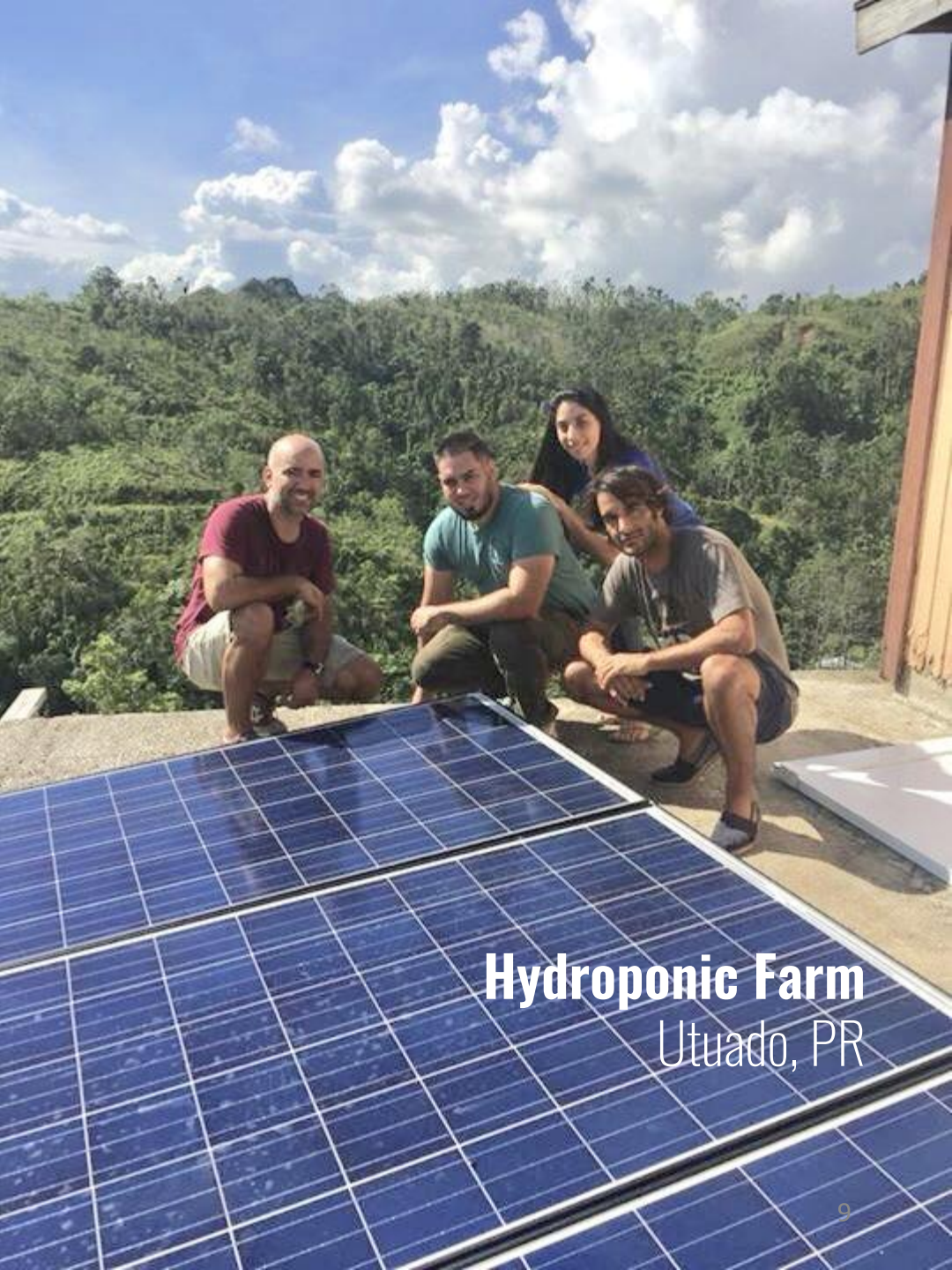
An acre of solar (500kw)

— donated by Ubiquiti Networks
— cargo jet sponsored by
the Hispanic Federation &
Lin Manuel Miranda



Donated Tesla Power Wall
Buena Vista Community Center
Cano Martin Pena, PR





Hydroponic Farm
Utuado, PR

Q&A

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- **Ian Munn**, Operations Manager, Solar Foundation
- **D. Ofelia Mangel**, Project Manager and Volunteer Coordinator, Resilient Power Puerto Rico
- **Devavrat Kadam**, Solar Engineer and Designer, Resilient Power Puerto Rico
- **Todd Olinsky-Paul**, Project Director, Clean Energy States Alliance (Moderator)



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