

Resiliency & Microgrids Working Group

Interconnection – Introduction and Scope

Resiliency and Microgrids Team, Energy Division

August 12, 2021



California Public
Utilities Commission

WebEx and Call-In Information

Join by Computer:

<https://cpuc.webex.com/cpuc/onstage/g.php?MTID=e89088fe875a5b30b40daaefcd8672bc0>

Event Password: RMWG21 (case sensitive)

Meeting Number: 146 348 4658

Join by Phone:

- Please register using WebEx link to view phone number.

(Staff recommends using your computer's audio if possible.)

Notes:

- Today's presentations are available in the meeting invite (follow link above) and will be available shortly after the meeting on <https://www.cpuc.ca.gov/resiliencyandmicrogrids>.
- The meeting will not be recorded. There will not be meeting minutes.

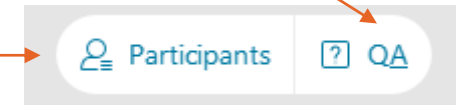
WebEx Logistics

- All attendees are muted on entry by default.
- Questions can be asked verbally during Q&A segments using the “raise hand” function.
 - The host will unmute you during Q&A portions [and you will have a maximum of 2 minutes to ask your question].
 - Please lower your hand after you’ve asked your question by clicking on the “raise hand” again.
 - If you have another question, please “re-raise your hand” by clicking on the “raise hand” button twice.
- Questions can also be written in the Q&A box and will be answered verbally during Q&A segments.

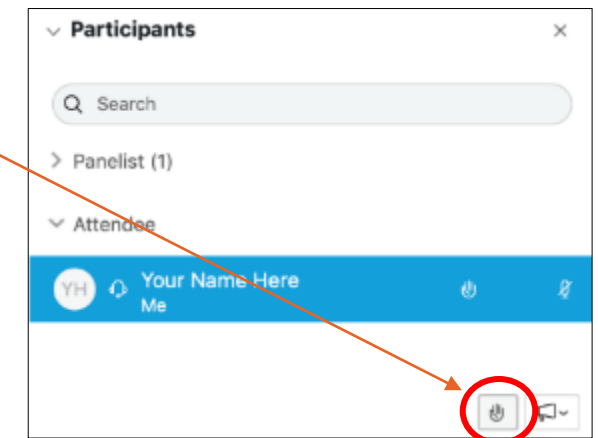
WebEx Tip

1. Click here to access the attendee list to raise and lower your hand.

Access the written Q&A panel here

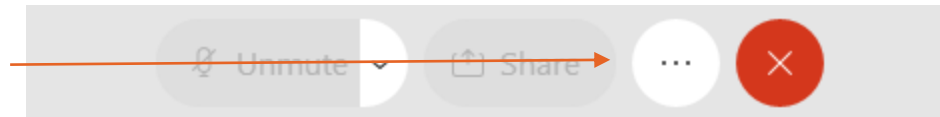


2. Raise your hand by clicking the hand icon.



3. Lower it by clicking again.

Access your meeting audio settings here



WebEx Event Materials

Event Information: Resiliency and Microgrids Working Group Meeting


Registration is required to join this event. If you have not registered, please do so now. [English](#) : [San Francisco Time](#)

Event status: Not started ([Register](#))

Date and time: Tuesday, March 2, 2021 9:30 am
Pacific Standard Time (San Francisco, GMT-08:00)
[Change time zone](#)

Duration: 1 hour

Description:



Event material: [RMWG Meeting Material_EXAMPLE.docx](#) (31.7 KB)

By joining this event, you are accepting the Cisco Webex [Terms of Service](#) and [Privacy Statement](#).

[Register](#) [Go Back](#)

[Join Event Now](#)

You cannot join the event now because it has not started.

First name:

Last name:

Email address:

[Join Now](#)

[Join by browser](#) **NEW!**

Preliminary Resiliency & Microgrids Working Group Schedule

Month	Resiliency and Microgrids Working Group Topics			
February	Standby Charges	Multi-Property Microgrid Tariff		
March				
April				
May				
June			Value of Resiliency	
July				
August				
September				
October				Microgrid Interconnection
November	Customer-Facing Microgrid Tariff Revisit			
December				
January				
February				

Interconnection: Working group participants will discuss interconnection and related issues as they specifically relate to microgrids. Topics will include interconnection requirements for grid-connected mode microgrid operations, controls, communications, and islanded mode microgrid operations where interconnection requirements are not applicable.

Agenda

- I. Introduction** (*CPUC Staff*) **2:00p – 2:05p**
- WebEx logistics, agenda review
- II. Brief Overview of Interconnection Sessions** (*Patrick Saxton, CPUC*) **2:05p – 2:15p**
- III. Direct Current Metering Update** (*Gregory Sheran, SCE*) **2:15p – 2:30p**
- Update from Southern California Edison on DC metering in compliance with D.21-01-018 ordering paragraph 11
 - Q&A and Discussion
- IV. Interconnection – Introduction & Scope** (*Patrick Saxton, CPUC*) **2:30p – 3:55p**
- Interactive discussion of scope and topic identification for remaining interconnection sessions of working group
- V. Closing Remarks, Adjourn** (*CPUC Staff*) **3:55p – 4:00p**
- Provide information on the next meeting

Brief Overview of Interconnection Sessions

Brief Overview of Interconnection Sessions

- Common to hear concerns related to interconnection
- Interconnection tariffs do not preclude microgrids but do not have explicit requirements for microgrids
- Interconnection only applies to generating facilities (includes storage) that operate in parallel with the distribution or transmission system

Tariff	Jurisdiction	Owner	Implementer	Applicable to
Rule 21	CPUC	IOUs	IOUs	NEM, Non-export, PURPA QFs
WDAT/WDT *	FERC	IOUs	IOUs	Interconnections to distribution system selling into wholesale market or directly to an IOU
* CAISO *	FERC	CAISO	CAISO	Interconnections to transmission system selling into wholesale market or directly to an IOU

Brief Overview of Interconnection Sessions

- In addition to interconnection, these sessions will cover related issues:
 - Controls
 - Communications
 - Islanded mode operations
 - Additional topics identified by participants

Objective

- Identify microgrid specific issues that may impede interconnection process for microgrids with resources that can parallel with grid
- Inform the multi-property microgrid tariff efforts
- Identify other actions (excluding financing and compensation) that could improve regulatory landscape for microgrids

Outcome

- Develop recommendations for identified issues

Example Outcomes (hypothetical)

- Identify specific issues for a formal working group
- Develop specific language for proposed modifications to Rule 21
- Recommend development of a new Rule applicable to microgrids that utilize a utility's distribution grid when in islanded mode
- Develop specific language for potential inclusion in a multi-property tariff

Ground Rules

- In Scope: Microgrid specific and aligned with CPUC's role and authority
- Out of scope: General interconnection, previous CPUC decision, scoped into different CPUC proceeding, addressed in other working group sessions*
 - Legal issues/interpretations related to P.U.C. § 218
 - Cost allocation of system upgrades required by interconnection studies
 - Exception - When specific to multi-property microgrids
 - Interconnection request application processing timelines and costs
 - Contractual terms or operating agreements for microgrids
 - Financing and compensation issues

* Cross-cutting issues related to multi-property microgrids are in scope for the interconnection sessions of the working group

Is DC Metering making the Hybrid Micro Grid Systems Possible ?

August 12, 2021

Greg Sheran

Consulting Engineer (SCE)

Energy for What's AheadSM



How will DC Metering help to make Micro Grid Possible ?

Agenda:

- Regulations and Governances
- DC metering Drivers
- Challenges for Micro Grids
- An Example of a 1P AC, at the meter MG
- DC MG Concept
- Conceptual Hybrid MG

Each of these areas has its own Innovations and challenges to address. With the integration of the best available technologies the Hybrid microgrid will start taking shape.

Governance & Policy

Policy/Regulations for DC Metering/System Roadmap

- ❑ CA Senate Bill-1339: **Electricity: microgrids: tariffs.**(Sept 2018)

Develop a standard for direct current metering in Electric Rule 21 to streamline the interconnection process and lower interconnection costs for direct current microgrid applications, pursuant to Section 8371(f), including net energy metering paired with storage systems and microgrids.

- ❑ ANSI DC Metering Standard Approved: C 12.32 (March 2021)

- ❑ FERC 2222 DER Aggregators (Sept 2020)

DERs are located on the distribution system, a distribution subsystem or behind a customer meter. They range from electric storage and intermittent generation to distributed generation, demand response, energy efficiency, thermal storage and electric vehicles and their charging equipment.

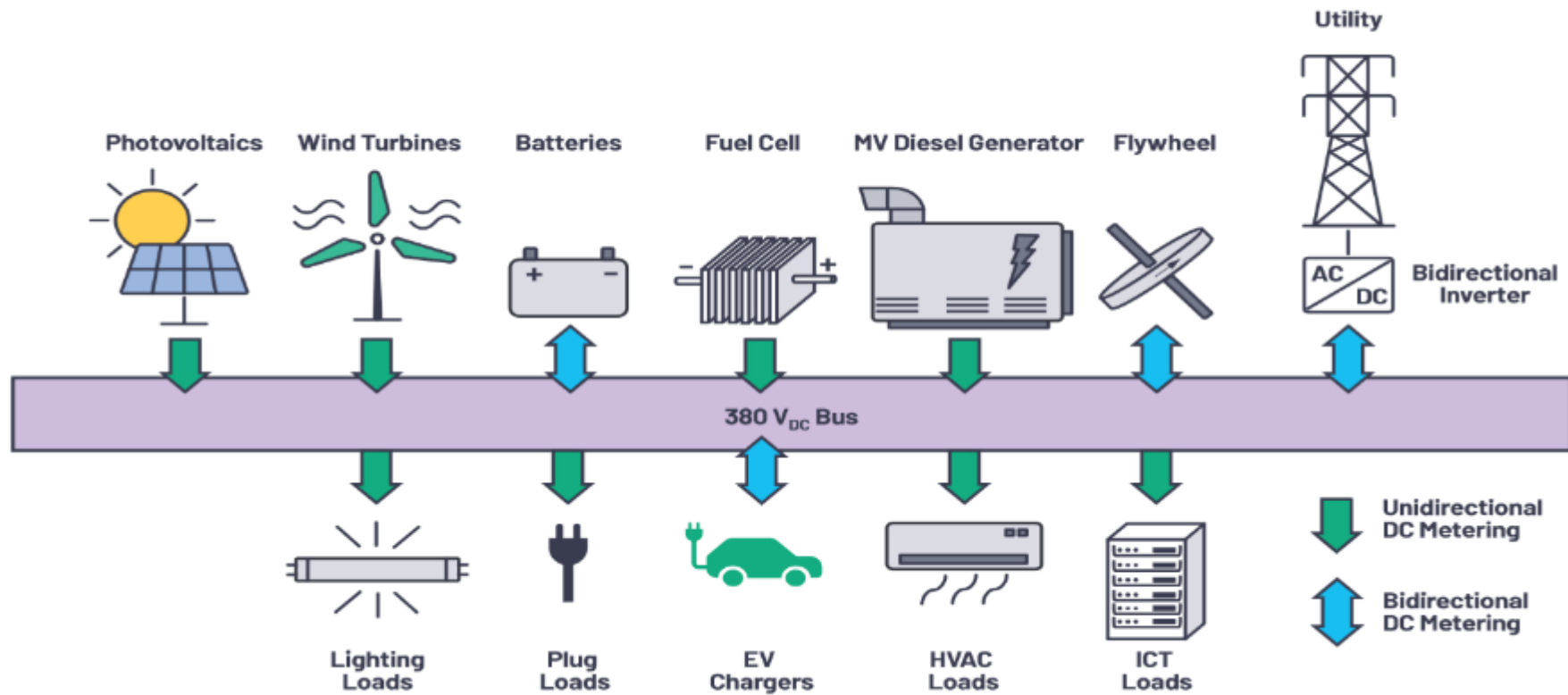
What comes next?

Regional grid operators must revise their tariffs to establish DERs as a category of market participant. These tariffs will allow the aggregators to register their resources under one or more participation models that accommodate(s) the physical and operational characteristics of those resources.

- ❑ Each tariff must set a size requirement for resource aggregations that do not exceed 100 kW.
- ❑ The tariffs also must address technical considerations such as:
 - locational requirements for DER aggregations;
 - distribution factors and bidding parameters;
 - information and data requirements;
 - metering and telemetry requirements; and
 - coordination among the regional grid operator, the DER aggregator, the distribution utility and the relevant retail regulatory authority.

The rule also directs the grid operators to allow DERs that participate in one or more retail programs to participate in its wholesale markets and to provide multiple wholesale services, but to include any appropriate, narrowly designed restrictions necessary to avoid double counting.

DC Metering Drivers



DC or AC ?

THE CURRENT WAR

THE TALE OF AN EARLY TECH RIVALRY

DC

DIRECT CURRENT


The flow of electricity is in one direction only. The system operates at the same voltage level throughout and is not as efficient for high-voltage, long distance transmission.

Direct current runs through:

- Battery-Powered Devices
- Fuel and Solar Cells
- Light Emitting Diodes

"[TESLA'S] IDEAS ARE SPLENDID, BUT THEY ARE UTTERLY IMPRACTICAL."

- THOMAS EDISON



THOMAS EDISON VS. **NIKOLA TESLA**

You would have never found two geniuses so spiteful of each other beyond turn-of-the-century inventors Nikola Tesla and Thomas Edison. They worked together—and hated each other. Let's compare their life, achievements, and embittered battles.

AC

ALTERNATING CURRENT

Electric charge periodically reverses direction and is transmitted to customers by a transformer that could handle much higher voltages.

Alternating current runs through:

- Car Motors
- Radio Signals
- Appliances

"IF EDISON HAD A NEEDLE TO FIND IN A HAYSTACK, HE WOULD PROCEED AT ONCE... UNTIL HE FOUND THE OBJECT OF HIS SEARCH. I WAS A SORRY WITNESS OF SUCH DOINGS, KNOWING THAT A LITTLE THEORY AND CALCULATION WOULD HAVE SAVED HIM 90 PERCENT OF HIS LABOR."

- NIKOLA TESLA

1847 BORN 1858

Milan, Ohio	BIRTHPLACE	Srijan, Croatia
Wizard of Menlo Park	NICKNAME	Wizard of the West
Home-schooled and self-taught	EDUCATION	Studied math, physics, and mechanics at The Polytechnic Institute at Graz
Mass communication and business	FORTE	Electromagnetism and electromechanical engineering
Trial and error	METHOD	Getting inspired and seeing the invention in his mind in detail before fully constructing it

FALLING OUT

Edison promised Tesla a generous reward if he could smooth out his direct current system. The young engineer took on the assignment and ended up saving Edison more than \$100,000 (millions of dollars by today's standards). When Tesla said,

"Geeze to one person's ingenuity and twenty nine percent parsimonious."

Thomas Edison

LATE BLOOMER

Thomas Edison, the youngest in his family, didn't learn to talk until he was almost 4 years old.

WAR OF CURRENTS OFFICIALLY SETTLED

In 2007, Can Edison embed 125 years of direct current electricity service that began when Thomas Edison opened his power station in 1882. It changed to only provide alternating current.

Challenges for any type of Micro Grid

Micro Grid type

- AC (1P or 3P)
- DC
- Hybrid

DER Interface

- At the Meter
- Behind the Meter
- Infront of the Meter

DER Size

- Retail
- Wholesale
- Both

Grid Orientation

- Grid following
- Grid forming
- Both

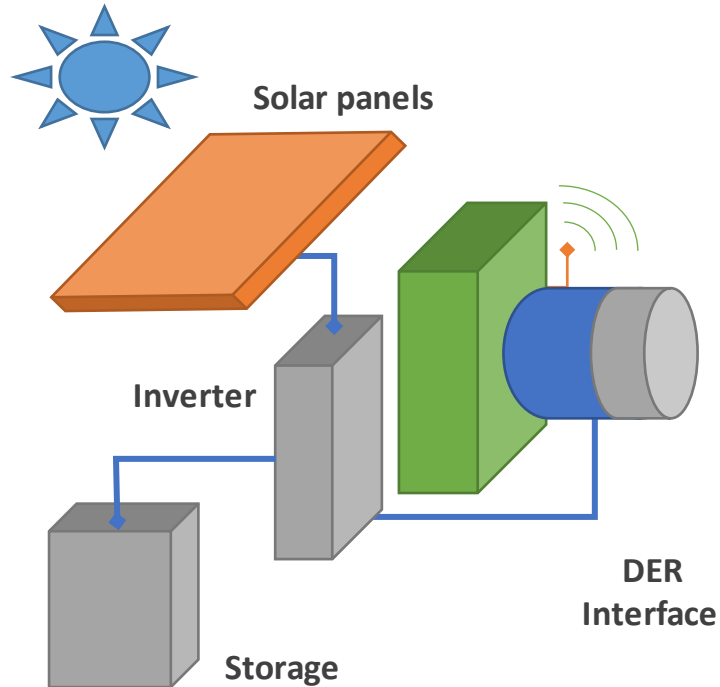
Grid Response

- Manual
- Automatic
- Controlled

Ownership/Control

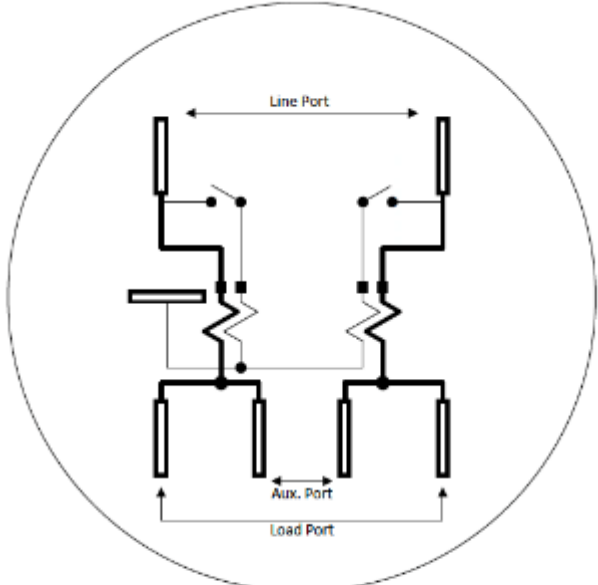
- Utility
- Customer
- DER provider
- Combination

Example of a 1P AC, at the meter MG



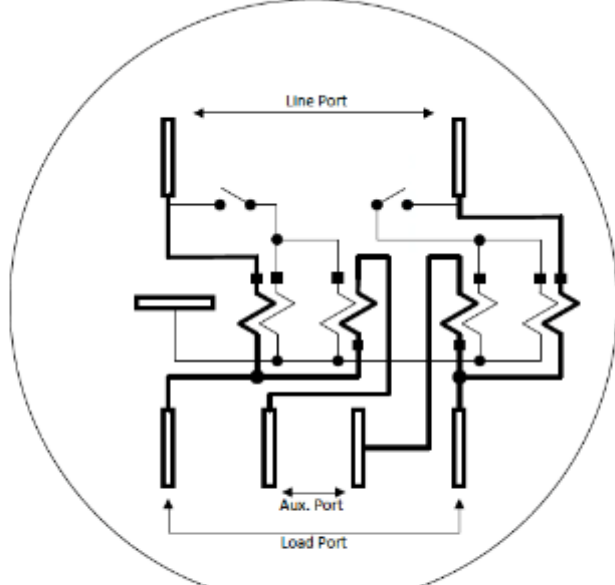
- Cutting home over to onsite power during service disruption (PSPS)
- Black Start Support
- Making every home outage proof
- Interconnection Standardization Service
- Production Monitoring and Alerts Service
- Remote Approval & PV System Activation
- Emergency Grid Stabilization
- PV Production Monitoring and Alerts
- Alternate Tariff Support
- PV/DER System Operation
- Virtual Power Plant (VPP)
- Peak Power shaving
- Load dis-aggregation

New ANSI Multi Port Meter



Form 425
2 Element, 3 Wire
3 Port*
Line Port Energy Measurement

*Port: A set of connections to deliver or receive energy.

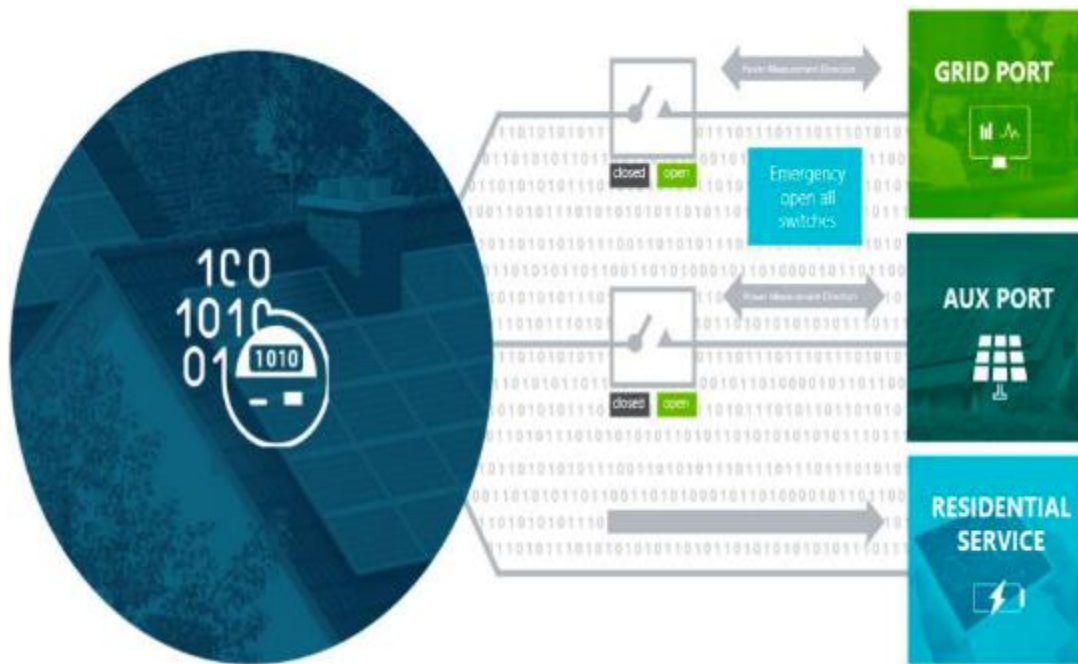


Form 435
4 Element, 3 Wire
3 Port*
Line Port & Aux. Port Energy Measurement

*Port: A set of connections to deliver or receive energy.

MICRO GRID MULTI PORT METERING:

Using Next Gen Multiport Meter for the different Micro Grid Use Cases



Use Cases

1. EV Submetering
2. Inverter Metering (Grid Following)
3. Manual Islanding (Grid Forming)
4. Auto Islanding (Both Grids)
5. DC Metering (standalone/hybrid)

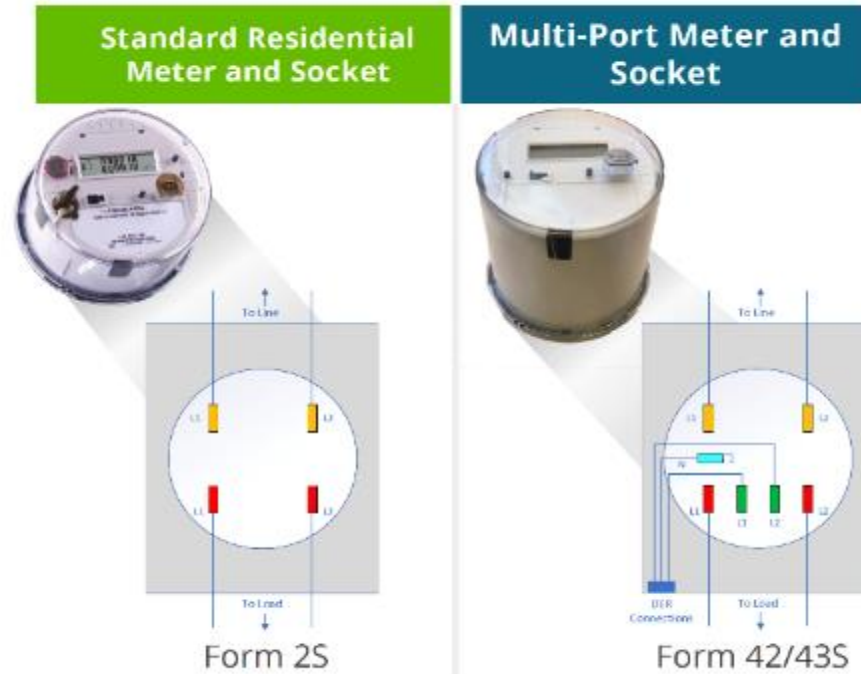
OVERVIEW OF A MULTI-POTY METER

STANDARDIZATION AND FORM FACTORS

Multi-Port Meter

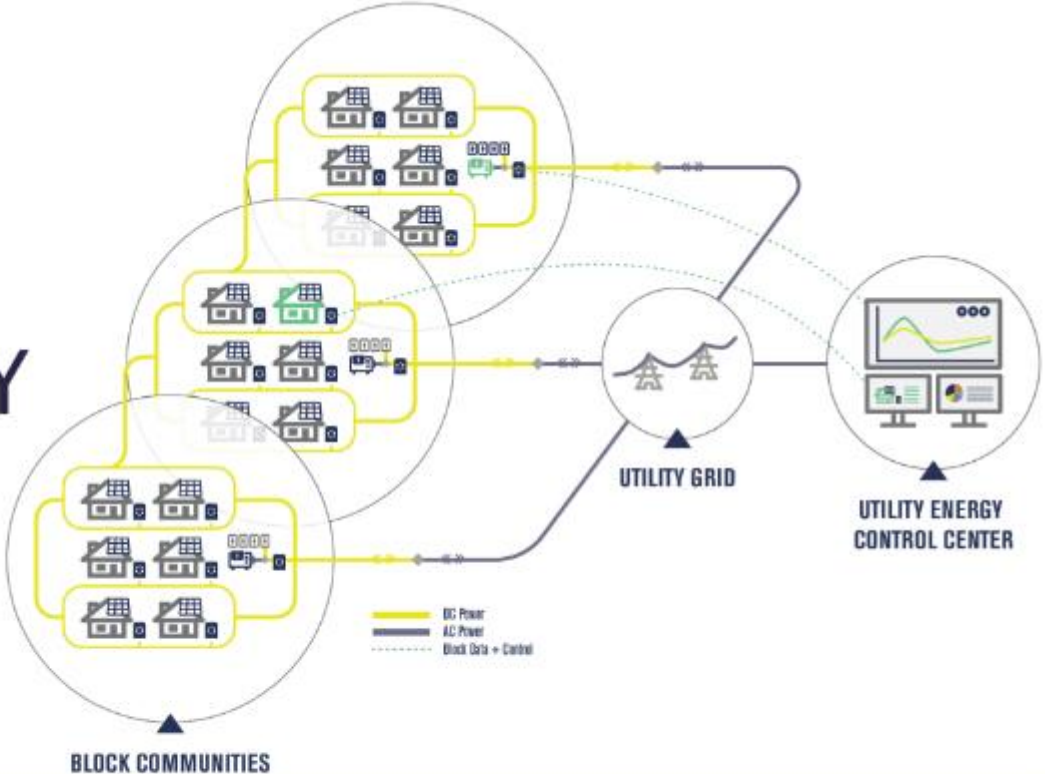
ANSI standards-based Technology

- Aesthetic, clean solution — No second meter. No conduit on top of the socket. No collar. All wiring is done through meter socket.
- Uses additional meter blades as connection point for DER
- Based on a new 42/43S ANSI Standard
- Socket is backwards compatible with existing 2S and 12S meters
- Revenue-Grade Measurement of Solar or other DER
- Multiple Disconnect Switches (320A Grid, 100A DER)
- Single metering solution for utilities



DC Community Energy Concept

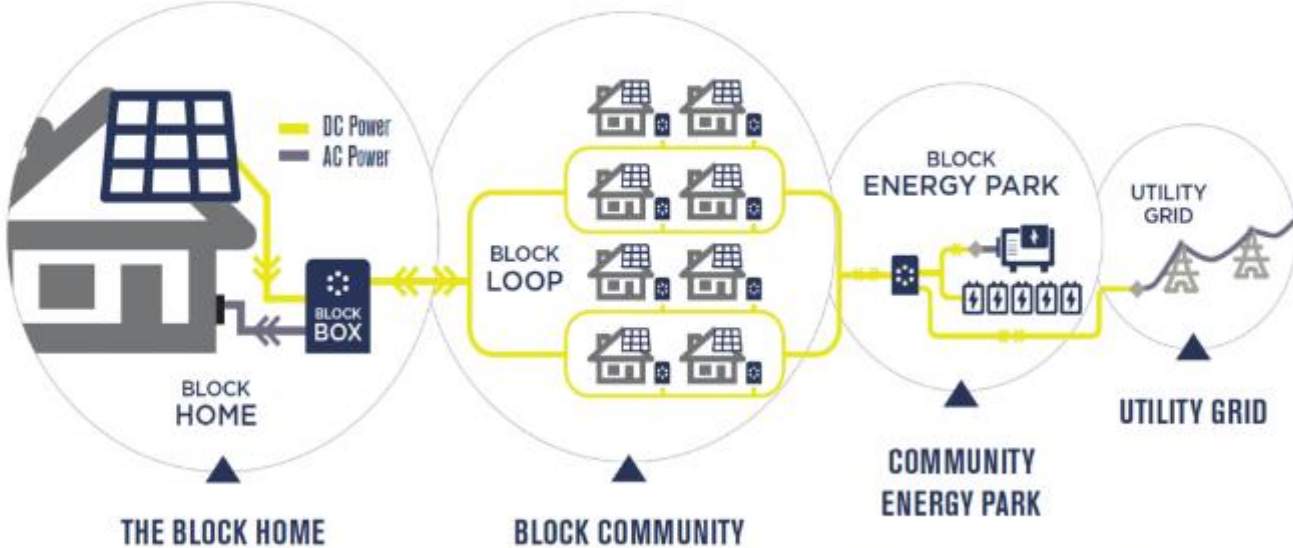
THE
NEW
COMMUNITY
ENERGY
CONCEPT



Conceptual Transactive Energy



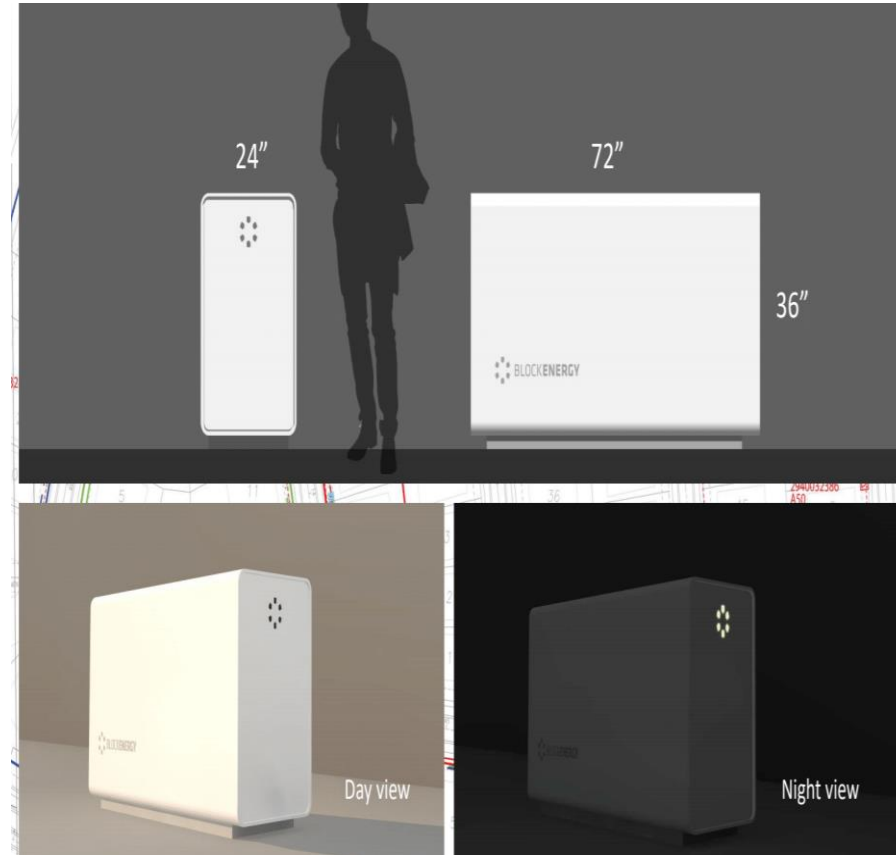
A distributed energy platform that seamlessly delivers mostly renewable and highly resilient energy through local, modular, and smart distribution networks based on proprietary architecture.



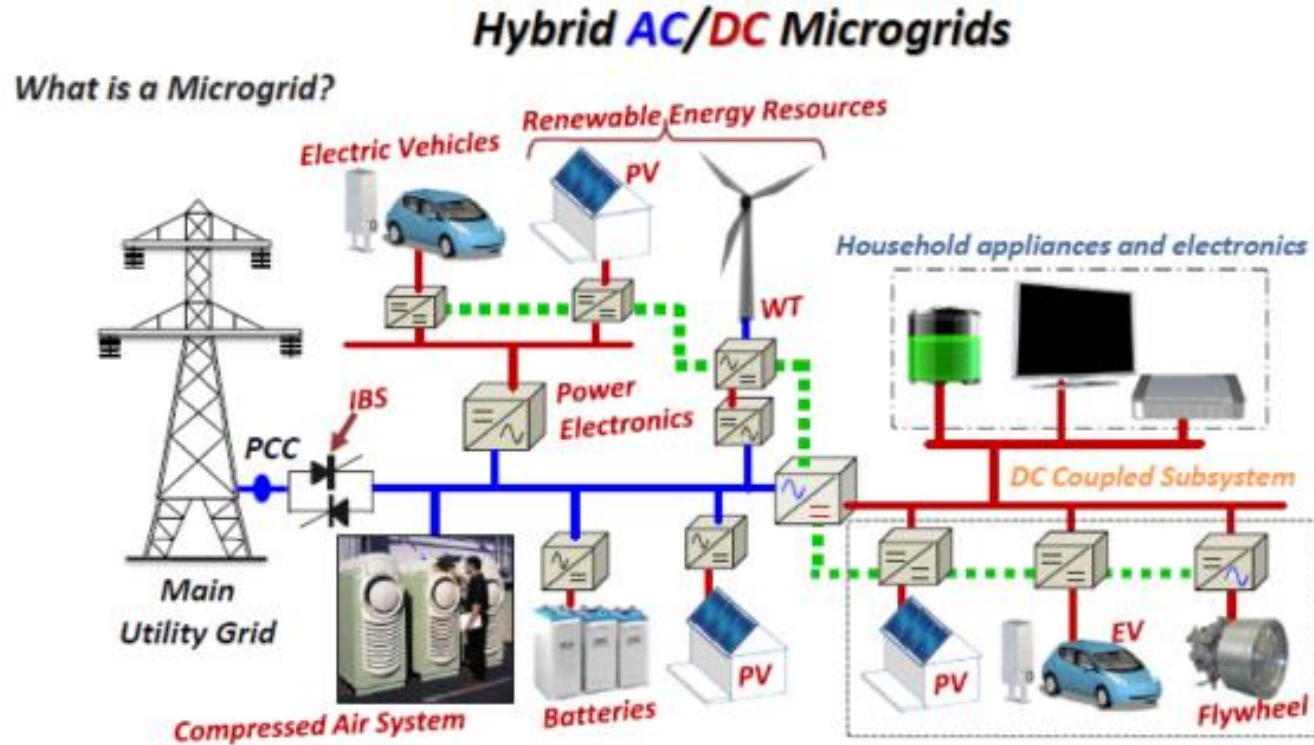
- Local & Renewable
- Resilient & Reliable
- DC Based
- Scalable
- Smart, Digital, Secure

Components of Conceptual Interface Box

- Modular design
- Battery Storage space
- DC to AC
- Transfer Switch
- AC Metering
- Load and Power Management
- Disconnect Switches
- Protection
- Realtime Comm Hub
- AC to DC
- DC Metering



Conceptual Hybrid AC/DC Microgrids



Thanks



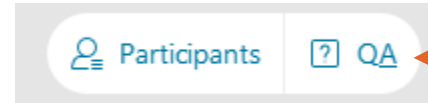
User experience

Design

Q&A and Discussion

WebEx Tip

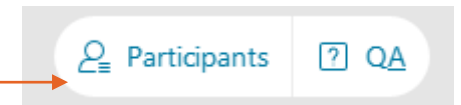
Option 1:



Access the written Q&A panel here

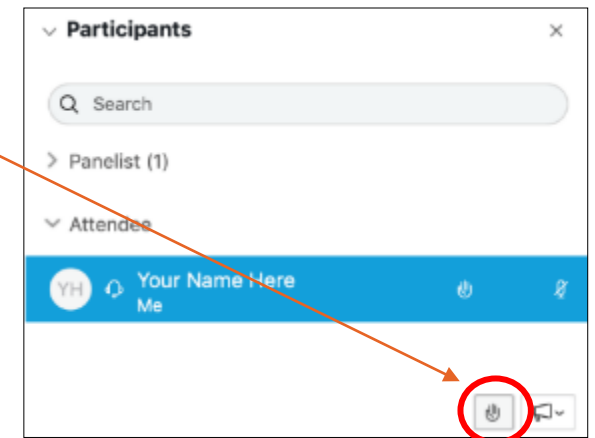
Option 2:

1. Click here to access the attendee list to raise and lower your hand.



2. Raise your hand by clicking the hand icon.

3. Lower it by clicking again.



Discussion Questions

1. Now that power control systems (PCS) are explicitly allowed in Rule 21 for DC-coupled battery energy storage systems, are there uses cases within the CPUC's jurisdiction for DC metering?
2. P.U.C. § 8371 (f) requires a DC metering standard to be developed within Rule 21. Are there any foreseeable unintended consequences or other considerations?

P.U.C. § 8371 (f) Develop a standard for direct current metering in the commission's Electric Rule 21 to streamline the interconnection process and lower interconnection costs for direct current microgrid applications.

Introduction and Scope

Introduction and Scope

- Interactive discussion
- Microgrid specific
- These working group sessions will cover:
 - Interconnection
 - Controls
 - Communications
 - Islanded mode operations
 - Additional topics identified by participants

Objective

- Identify microgrid specific issues that may impede interconnection process for microgrids with resources that can parallel with grid
- Inform the multi-property microgrid tariff efforts
- Identify other actions (excluding financing and compensation) that could improve regulatory landscape for microgrids

Interconnection

- Interconnection tariffs apply to grid-connected mode operations of microgrids, including disconnection from grid and reconnection to grid
- Tariffs are necessary to maintain safe and reliable grid operations
- Tariffs don't have explicit microgrid requirements
- Microgrid specific gaps in existing interconnection studies process when only behind-the-meter resources?
 - Asked in R.19-09-009 ALJ ruling requesting comment on Track 2 proposals
 - None identified

Interconnection

- D.20-09-035 (Adopting Recommendations From Rule 21 Working Groups Two, Three, And V2G-AC Subgroup)
 - Removed capacity from eligibility criteria for Rule 21 Fast Track
 - Fast Track eligibility now based on Integration Capacity Analysis (ICA)
 - Found no changes necessary to help projects move from Rule 21 to WDAT/WDT process

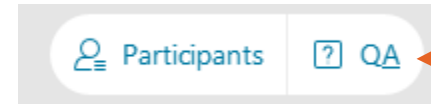
Interconnection – Microgrid Controllers

- Microgrid controllers manage power flows and disconnection/reconnection from grid
 - No explicit requirements in interconnection tariffs
 - Inverters do have explicit requirements
- Areas to consider:
 - Functional requirements (e.g., disconnect/reconnect transition/synchronization)
 - Communications (e.g., IEEE 2030.5-202018 - IEEE Standard for Smart Energy Profile Application Protocol, Common Smart Inverter Profile)
 - Cybersecurity
 - Commissioning

Q&A and Discussion

WebEx Tip

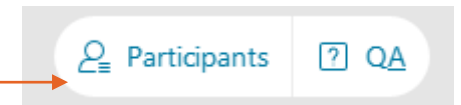
Option 1:



Access the written Q&A panel here

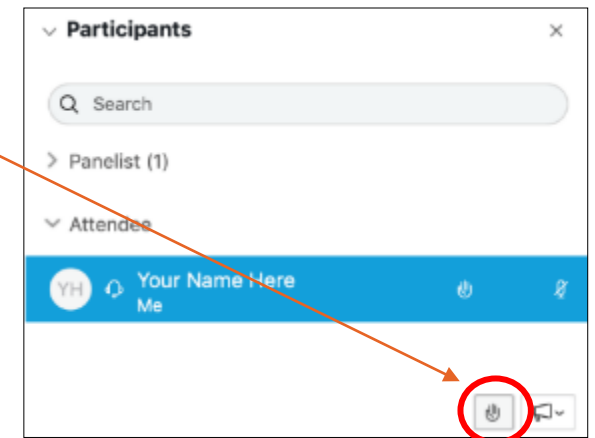
Option 2:

1. Click here to access the attendee list to raise and lower your hand.



2. Raise your hand by clicking the hand icon.

3. Lower it by clicking again.



Interconnection – Discussion Questions

1. Are there microgrid specific gaps in existing interconnection processes?
2. What attributes or characteristics of microgrids are not adequately addressed by Rule 21? By WDAT/WDT? By CAISO Tariff?
3. Should specifications or requirements for microgrid controllers be developed?
 - In which areas, if any, are existing Rule 21 requirements for inverters applicable and adequate?
4. Are there overlaps or interactions with the Unintentional Islanding Working Group from D.21-06-002? See D.21-06-002 Appendix B.
5. Are there other issues to be considered for interactions between Rule 21, WDAT/WDT, and CAISO Tariff?

Islanded Mode Operations

- When all elements of microgrid are on single premise and customer side of the utility meter:
 - Islanded mode operations outside of CPUC and utility jurisdiction
 - Rely on microgrid operator to maintain safety and operating conditions
- When a utility's distribution grid is utilized during islanded mode operations (e.g., multi-property microgrid, community microgrid):
 - Subject to CPUC and utility jurisdiction
 - No comprehensive tariff currently exists
 - CPUC approved, on experimental basis, PG&E's Community Microgrid Enablement Tariff (CMET)

Islanded Mode Operations

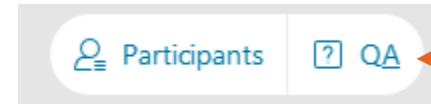
- CMET identifies relevant issues:
 - Microgrid Islanding Study *
 - Maintain operating conditions within PG&E parameters:
 - Voltage
 - Frequency
 - Power quality

* Microgrid islanding study covered in depth at meeting on August 27, 2021

Q&A and Discussion

WebEx Tip

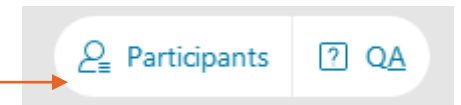
Option 1:



Access the written Q&A panel here

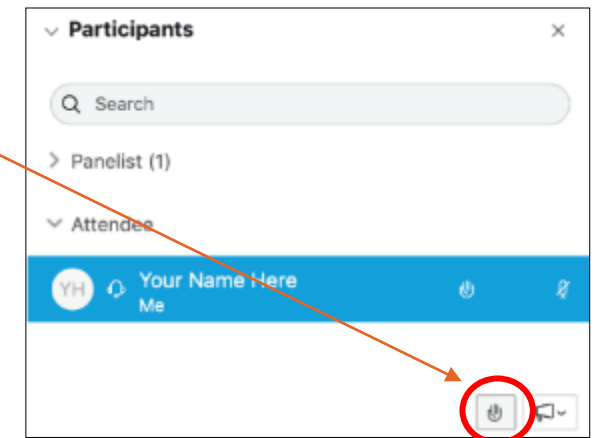
Option 2:

1. Click here to access the attendee list to raise and lower your hand.



2. Raise your hand by clicking the hand icon.

3. Lower it by clicking again.



Islanded Mode Operations – Discussion Questions

1. Are there issues not identified in CMET that should be included in these working group sessions?

Other Potential Topics

- Set of definitions or a glossary for microgrids and associated equipment could help facilitate technical discussions
- Some stakeholders suggested additional interconnection application single-line diagram templates would be useful
 - IOU compliance filings showed very minimal use of templates ordered in D.20-06-017
 - More complex microgrids seem less likely to have standardized designs

Other Potential Topics

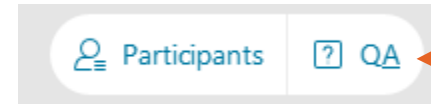
- Microgrids can act as a single controllable entity and limit the amount of electricity imported or exported across the point of common coupling (PCC) *
 - Could a microgrid with a multitude of generation resources, battery energy storage systems, and EV chargers be studied as group based on the aggregate operating characteristics of the microgrid?
 - What is the potential to study combined generation and load at PCC?

* Point of common coupling is the point in the power system at which the electric utility and the customer interface occurs. Typically, but not always, it is the customer side of the utility revenue meter

Q&A and Discussion

WebEx Tip

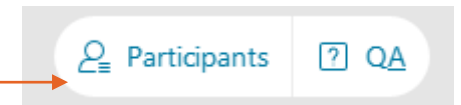
Option 1:



Access the written Q&A panel here

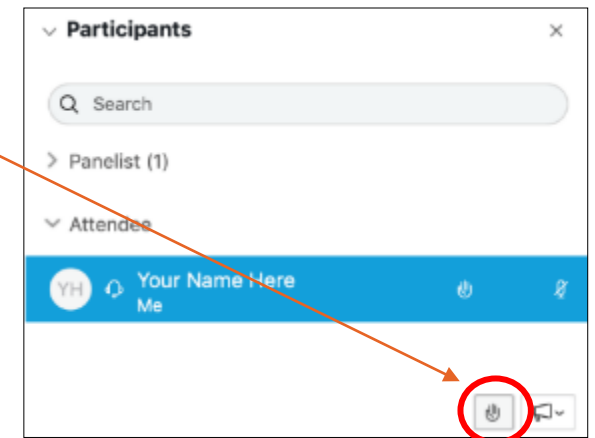
Option 2:

1. Click here to access the attendee list to raise and lower your hand.



2. Raise your hand by clicking the hand icon.

3. Lower it by clicking again.



Other Potential Topics – Discussion Questions

1. Should common definitions/glossary be developed?
2. Should additional single-line diagram templates be developed?
3. Should further discussions be held on combined study of generation and load at the PCC?
 - What types of assurances and controls (e.g., relays) would be required to allow future consideration of this approach?
 - What changes, if any, to the existing interconnection process or existing service upgrade process (for load addition) may be warranted now or in the future?
4. What other topics should be covered in these working group sessions?

Closing and Upcoming Meetings

Upcoming Meetings

- **Friday, August 27, 2021, 2:15 p.m. – 4:30 p.m.**
 - Presentation by Pacific Gas and Electric on Microgrid Islanding Study
 - Operational requirements for microgrids utilizing a utility distribution grid when in islanded mode
 - From technical perspective only, discuss concept of a community microgrid that serves only critical facility loads (i.e., non-critical facility loads are de-energized)
- **Thursday, September 9, 2021 (afternoon) (tentative)**
 - Presentation by San Diego Gas & Electric – Experience integrating microgrids into their system
 - Presentation by TBD on microgrid controls



California Public Utilities Commission

Patrick.Saxton@cpuc.ca.gov

<https://www.cpuc.ca.gov/resiliencyandmicrogrids/>