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# CPUC Diesel Alternative Workshop

# Neighborhood Grids

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# Covelo, CA needs a solution to protect its residents through multi-day outages

## Problems with Diesel Generation Solution Today

- **Dirty and polluting:** Rotating generators emit particulate matter and both nitrogen and sulfur oxides which can pose significant health risks, and pollutes environment.
- **Unsustainable:** Requires refueling with difficult logistics
- **Expensive:** Requires standby and mobilization costs for every PSPS event
- **No benefits to ratepayers or grid during non-outage times**

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# Sunrun proposes a **permanent, renewable, distributed** solution to **power all customers through PSPS**, as well as **reduce load during normal operations**

## Proposed Solution

- Electricity to be provided from renewables that are **generated and stored on-site**
- Ability to **share power and support the local needs** within the distribution network
- Ability for feeders to **temporarily disconnect at the substation**, and stay powered

## Benefits

- **Individuals:** Clean, local, and resilient power
- **Utility:** Continued service to all ratepayers even during transmission outages, and reduced system cost due to cost-sharing with Sunrun solar customers
- **Society:** Increased adoption of rooftop solar and battery storage will reduce carbon emissions, grow the economy, and empower communities

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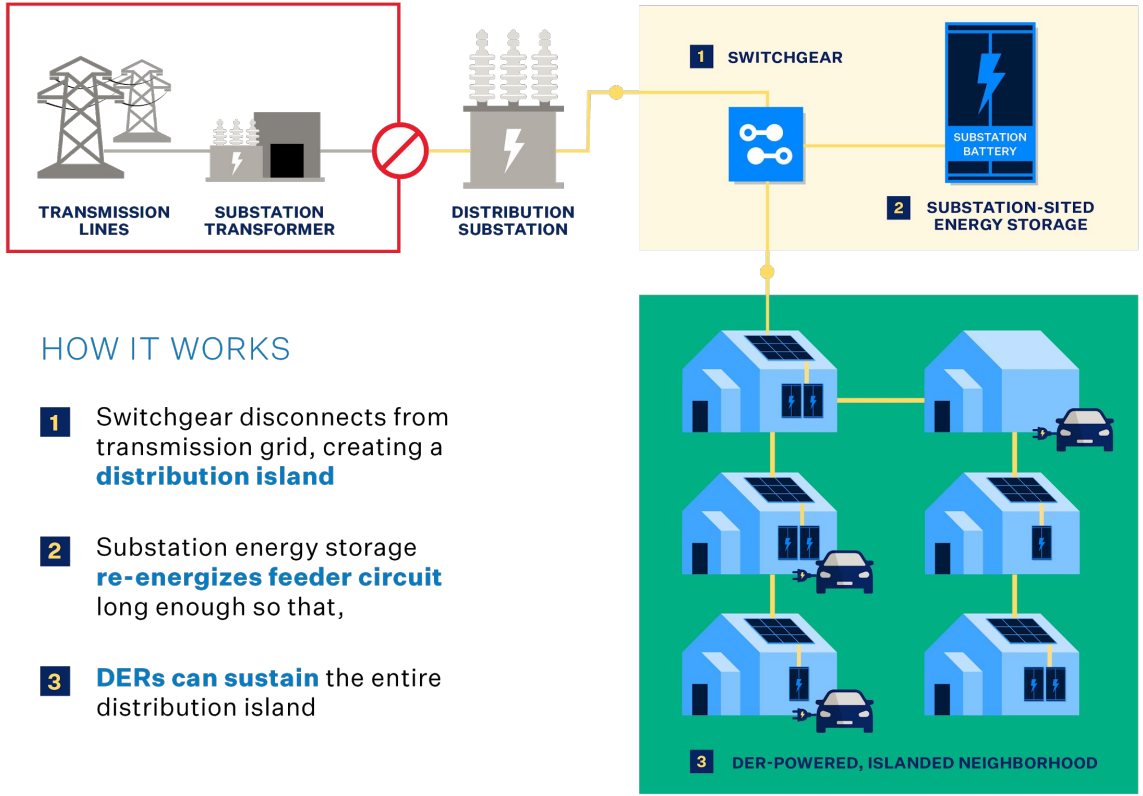
# Neighborhood Grid Concept




## HOW IT WORKS

1. Switchgear disconnects from transmission grid, creating a **distribution island**
2. Substation energy storage **re-energizes feeder circuit** long enough so that,
3. **DERs can sustain** the entire distribution island

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# Neighborhood Grid provides benefits to local community and grid **during both PSPS and Normal Operation**

| | Neighborhood Grid | Diesel Generators |
|---|---|---|
| **What is the generation source?** | Distributed solar + storage<br>Centralized solar + storage<br>Fuel Cells | Diesel |
| **How long does it last?** | 10 years + | 1 year |
| **When can I use it?** | Year-round | PSPS only |
| **What are the benefits?** | Provide power during PSPS<br>Load reduction<br>Clean, renewable power | Provide power during PSPS |
| **Cost Sharing** | Utility<br>Solar + Storage customers | Utility only |
| **Cost to Utility (10 years)** | $16 M | $19 M |

# A mix of permanent residential and utility-sited solar + storage can supply Covelo for 48 hours for less than the cost of running diesel generators for 10 years

| | Cost-Optimized | | Hybrid | | Carbon-Optimized | |
|---|---|---|---|---|---|---|
| | 5MW PV, 9 MWH Storage | | 5MW PV, 60 MWH Storage | | 10 MW PV, 60 MWH Storage | |
| **Solar** | Low | Low | Low | Low | High | High |
| **Storage** | Low | Low | High | High | High | High |
| **Fuel Cell** | High | High | Low | Low | None | None |
| **Residential Penetration** | Low | High | Low | High | Low | High |
| **Total Solar (MW)** | 5.00 | 5.00 | 5.00 | 5.00 | 10.00 | 10.00 |
| **Total Storage (MWh)** | 9.00 | 9.00 | 60.00 | 60.00 | 60.00 | 60.00 |
| **Residential Solar (MW)** | 2.44 | 4.88 | 2.44 | 4.88 | 2.44 | 4.88 |
| **Residential Storage (MWh)** | 4.39 | 8.79 | 4.39 | 8.79 | 4.39 | 8.79 |
| **Utility Solar (MW)** | 2.56 | 0.12 | 2.56 | 0.12 | 7.56 | 5.12 |
| **Utility Storage (MWh)** | 4.61 | 0.21 | 55.61 | 51.21 | 55.61 | 51.21 |
| **Utility Fuel Cell (MW)** | 1.40 | 1.40 | 0.20 | 0.20 | 0.00 | 0.00 |
| **Total System Cost** | $25 | $33 | $32 | $40 | $37 | $45 |
| **Utility Cost[1]** | $16 | $15 | $23 | $22 | $28 | $27 |
| **Residential Cost** | $9 | $18 | $9 | $18 | $9 | $18 |

[1] Excludes resiliency value of storage to substation and grid at large. Based on prevailing storage incentives, the former is likely worth $2-4 MM in the cost optimized case and $15-25 MM in the other two cases. For the latter, would require the help of the utility to conduct a grid transmission study.

# Example Outage

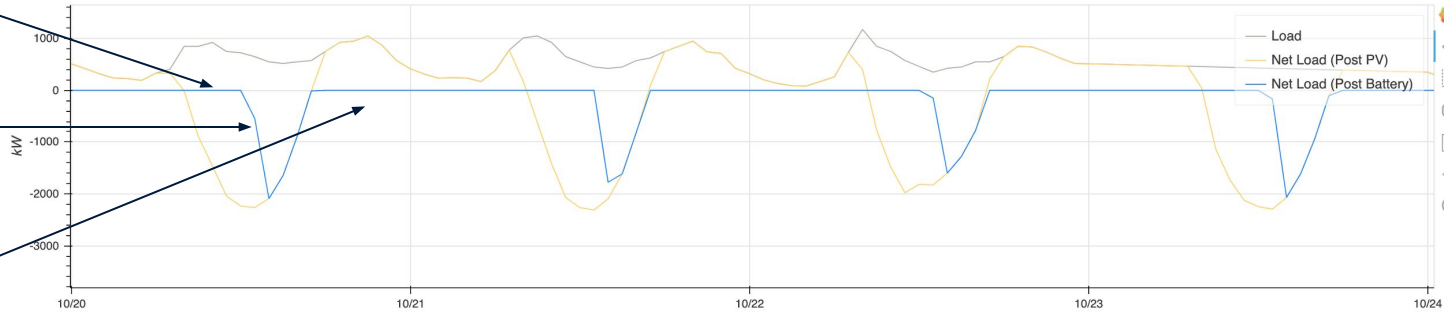
## 3 Tesla Megapacks, 5 MW PV, 1.4 MW Fuel Cell

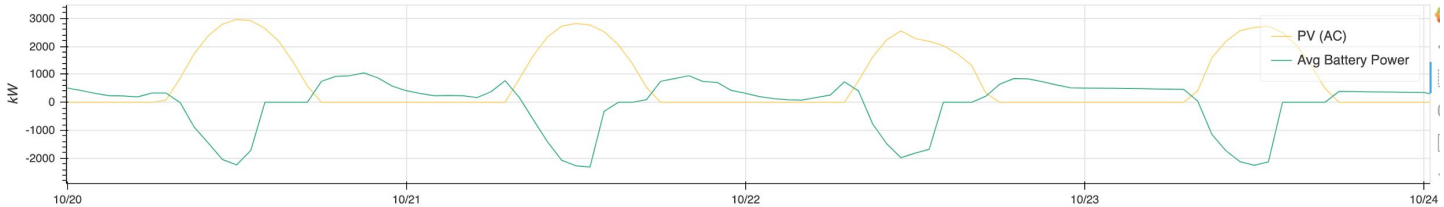
Fuel cell runs continuously during outage to reduce load (not shown)

Charging on excess generation

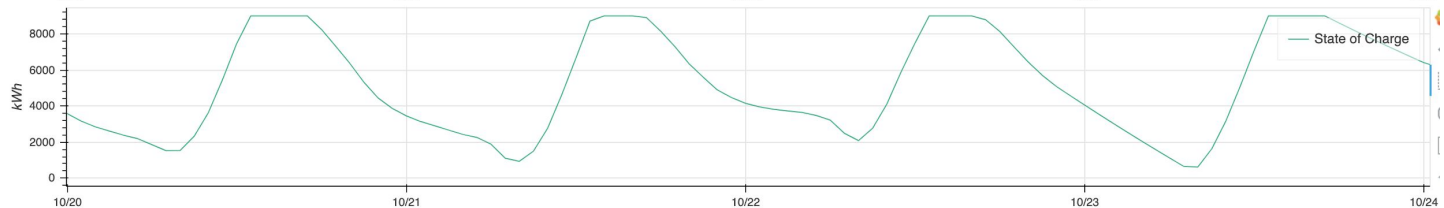
Battery is full, solar curtailed

Battery discharges to serve load




Battery state of charge



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# Implementation Plan

- The Neighborhood Grid solution for Covelo can be 100% deployed by 10/21. Specifically:

| Resource | Residential Solar + Storage | non-Residential Solar + Storage | Fuel Cell |
|---|---|---|---|
| Amount | 2.5 - 5 MW Solar<br>4.5 - 9 MWh Storage | 0 - 2.5 MW Solar<br>0 - 4.5 MWh Storage | 1.4 MW |
| Delivery Date | By 10/2021: 100% | By 10/2021: 100% | By 10/2021: 100% |

- To achieve this level of residential solar + storage penetration, the following would be required:
  a. Aggressive co-marketing with PG&E, starting in Q4 2020
  b. A 20% solar subsidy for residential customers
  c. An elimination of minimum utility bills for residential customers
  d. A 50% storage subsidy for residential customers
  e. PG&E ownership of non-residential asset deployment OR partnership with other entities

- Covelo is an ideal location for the Neighborhood Grid solution because:
  a. The relatively small substation load requires fewer residential installations
  b. The housing stock appears to primarily be single family homes with ample roof space
  c. Ample land to site the non-distributed solar and storage

# Appendix

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# Cost Breakdown

| Solutions | 5MW PV, 9 MWH Storage | | 5MW PV, 60 MWH Storage | | 10 MW PV, 9 MWH Storage | | 10 MW PV, 60 MWH Storage | |
|---|---|---|---|---|---|---|---|---|
| Total solar (kW) | 5,000 | 5,000 | 5,000 | 5,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| Total battery capacity (kWh) | 9,000 | 9,000 | 60,000 | 60,000 | 9,000 | 9,000 | 60,000 | 60,000 |
| Fuel cell (kW) | 1,400 | 1,400 | 200 | 200 | 1,400 | 1,400 | 0 | 0 |
| Sunrun penetration | 15% | 30% | 15% | 30% | 15% | 30% | 15% | 30% |
| Resi systems (#) | 163 | 326 | 163 | 326 | 163 | 326 | 163 | 326 |
| Resi solar (kW) | 2,441 | 4,883 | 2,441 | 4,883 | 2,441 | 4,883 | 2,441 | 4,883 |
| Resi storage (kWh) | 4,394 | 8,789 | 4,394 | 8,789 | 4,394 | 8,789 | 4,394 | 8,789 |
| Utility solar (kW) | 2,559 | 118 | 2,559 | 118 | 7,559 | 5,118 | 7,559 | 5,118 |
| Utility storage (kWh) | 4,606 | 212 | 55,606 | 51,212 | 4,606 | 212 | 55,606 | 51,212 |
| | | | | | | | | |
| **Costs** | | | | | | | | |
| Residential Solar | $7,812,000 | $15,624,000 | $7,812,000 | $15,624,000 | $7,812,000 | $15,624,000 | $7,812,000 | $15,624,000 |
| Residential Storage | $1,302,000 | $2,604,000 | $1,302,000 | $2,604,000 | $1,302,000 | $2,604,000 | $1,302,000 | $2,604,000 |
| **Total Residential Customer costs** | **$9,114,000** | **$18,228,000** | **$9,114,000** | **$18,228,000** | **$9,114,000** | **$18,228,000** | **$9,114,000** | **$18,228,000** |
| | | | | | | | | |
| Utility Solar | $3,070,500 | $141,000 | $3,070,500 | $141,000 | $9,070,500 | $6,141,000 | $9,070,500 | $6,141,000 |
| Utility Storage | $1,289,610 | $59,220 | $15,569,610 | $14,339,220 | $1,289,610 | $59,220 | $15,569,610 | $14,339,220 |
| Utility Fuel cell | $8,400,000 | $8,400,000 | $1,200,000 | $1,200,000 | $8,400,000 | $8,400,000 | $0 | $0 |
| Utility Fuel costs | $90,720 | $90,720 | $12,960 | $12,960 | $90,720 | $90,720 | $0 | $0 |
| Utility subsidy for residential solar | $1,953,000 | $3,906,000 | $1,953,000 | $3,906,000 | $1,953,000 | $3,906,000 | $1,953,000 | $3,906,000 |
| Utility subsidy for residential storage | $1,302,000 | $2,604,000 | $1,302,000 | $2,604,000 | $1,302,000 | $2,604,000 | $1,302,000 | $2,604,000 |
| *Utility benefit from resilience* | *$2,250,000* | *$2,250,000* | *$15,000,000* | *$15,000,000* | *$2,250,000* | *$2,250,000* | *$15,000,000* | *$15,000,000* |
| **Total Utility Costs (without resilience benefit)** | **$16,105,830** | **$15,200,940** | **$23,108,070** | **$22,203,180** | **$22,105,830** | **$21,200,940** | **$27,895,110** | **$26,990,220** |
| | | | | | | | | |
| Total Solution Cost | **$25,219,830** | **$33,428,940** | **$32,222,070** | **$40,431,180** | **$31,219,830** | **$39,428,940** | **$37,009,110** | **$45,218,220** |
| % of solution paid for by Resi Customers | 36% | 55% | 28% | 45% | 29% | 46% | 25% | 40% |
| | | | | | | | | |
| Diesel gen costs (1 year) | **$1,933,667** | **$1,933,667** | **$1,933,667** | **$1,933,667** | **$1,933,667** | **$1,933,667** | **$1,933,667** | **$1,933,667** |
| **Diesel gen costs (10 years)** | **$19,336,667** | **$19,336,667** | **$19,336,667** | **$19,336,667** | **$19,336,667** | **$19,336,667** | **$19,336,667** | **$19,336,667** |
| Utility Savings (without resilience benefit) | $3,230,837 | $4,135,727 | -$3,771,403 | -$2,866,513 | -$2,769,163 | -$1,864,273 | -$8,558,443 | -$7,653,553 |