

Shining Light on Energy, and The Solar Industry 2.0

SICK.CODES

HITBSecConf

Phuket, Thailand 2023



Disclaimer – An Opinion

- Independent research
 - Educational purposes only
 - No affiliation with any entity in this presentation
 - All research was conducted in good faith
 - Nothing today represents any beliefs, employers, past employers, or future employers
 - All content in the slides is CC0
 - All other trademarks, logos and brand names are the property of their respective owners
-

Sick Codes – good faith hackerman

<https://github.com/sickcodes>

<https://twitter.com/sickcodes>

<https://linkedin.com/in/sickcodes>

<https://sick.codes>



sickcodes Follow

Overview Repositories 195 Projects Packages Stars 218 Sponsoring 4

Contractor (Always available!) | Securit...

Australiasia

<https://sick.codes>

@sickcodes

Sponsors

Sponsoring

Docker-OSX Public

Run macOS VM in a Docker! Run near native OSX-KVM in Docker! X11 Forwarding! CI/CD for OS X Security Research! Docker mac Containers.

Shell 23.4k 1.1k

osx-serial-generator Public

Mac Serial Generator - Generate complete sets of Serial Numbers for OSX-KVM, Docker-OSX and of course, OpenCore.

Shell 1.3k 81

dock-droid Public

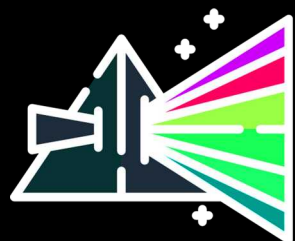
Docker Android - Run QEMU Android in a Docker! X11 Forwarding! CI/CD for Android!

Dockerfile 292 24

Docker-eyeOS Public

Run iPhone (xnu-arm64) in a Docker container! Supports KVM iOS kernel debugging (GDB)! Run xnu-qemu-arm64 in Docker! Works on ANY device.

Shell 561 54



Automated Security Research

ADVANCED HARDWARE ATTACK TRAINING

ADVANCED HARDWARE ATTACK TRAINING

INTIMATE

*hands-on electrical
reverse engineering, with
SPI, I2C, UART, SWD, JTAG, etc.*

HARDWARE &
HACKING

**FIRMWARE
MODIFICATION**

SMD/BGA
REWORK

HACKING

MODERN HARDWARE

*Learn immediately actionable hardware
attack vectors for up-to-date devices.*

*Get repeatable, procedural vulnerability
discovery techniques, that have real-world
consequences.*

ALL TOOLS PROVIDED

*Take the tools home with you, with all
adapters, cables, converters, solder, flux,
connectors, clamps, etc. provided in the
training.*

**ARRANGE
SESSIONS**



307 240 2189

This talks is suitable for

This talk is suitable for

- Anyone who uses electricity**

What am I

What am I

- Good intentions

What am I

- Good intentions
- I follow all CFAA laws!

What am I

- Good intentions
- I follow all CFAA laws!
- Just the messenger

What I'm not

What I'm not

- A threat actor

What I'm not

- A threat actor
- Not an expert

Today's session

- Not a lecture

Today's session

- Not a lecture
- Read between the lines..

Today's session

- Not a lecture
- Read between the lines..
- Not overly technical



ZELLWEGER USTER LTD AUCKLAND
DECABIT RE1
RIPPLE CONTROL RECEIVER
SUPPLY VOLTAGE 230 V 50 Hz
CONTROL FREQUENCY 1050 Hz 1.1 V
SWITCH RATING 40 A 400 V
SERIAL NO

RE
100-05

40A
415V~

ZELLWEGER USTER LTD AUCKLAND
DECABIT RE1
RIPPLE CONTROL RECEIVER
SUPPLY VOLTAGE 230 V 50 Hz
CONTROL FREQUENCY 1050 Hz 1.1 V
SWITCH RATING 40 A 400 V
SERIAL NO

ZELLWEGER USTER LTD AUCKLAND

DECABIT RE 1

RIPPLE CONTROL RECEIVER

SUPPLY VOLTAGE	230 V	50 Hz
CONTROL FREQUENCY	1050 Hz	1.1 V
SWITCH RATING	40 A	400 V

SERIAL NO

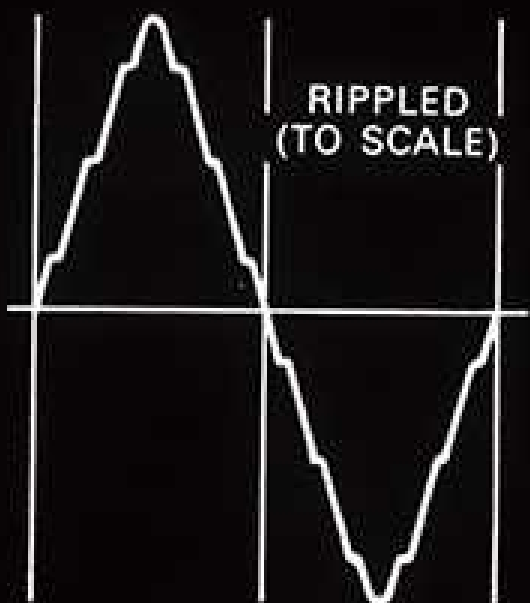
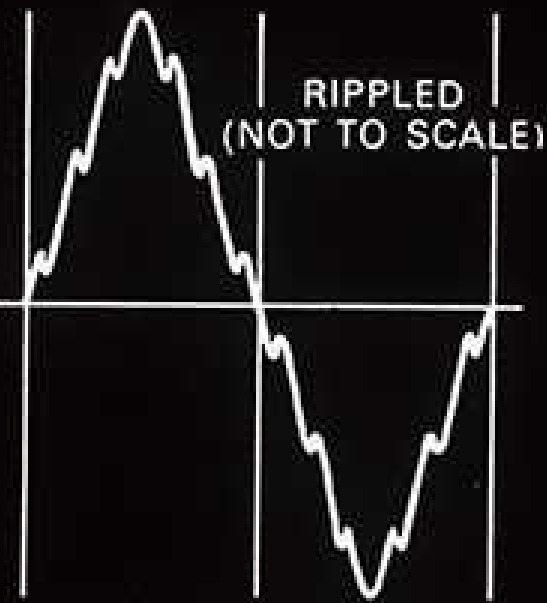


EDMI Atlas Mk7A



allows **disconnection** and
reconnection of
electrical services
remotely...

...read **remotely** for
billing purposes...



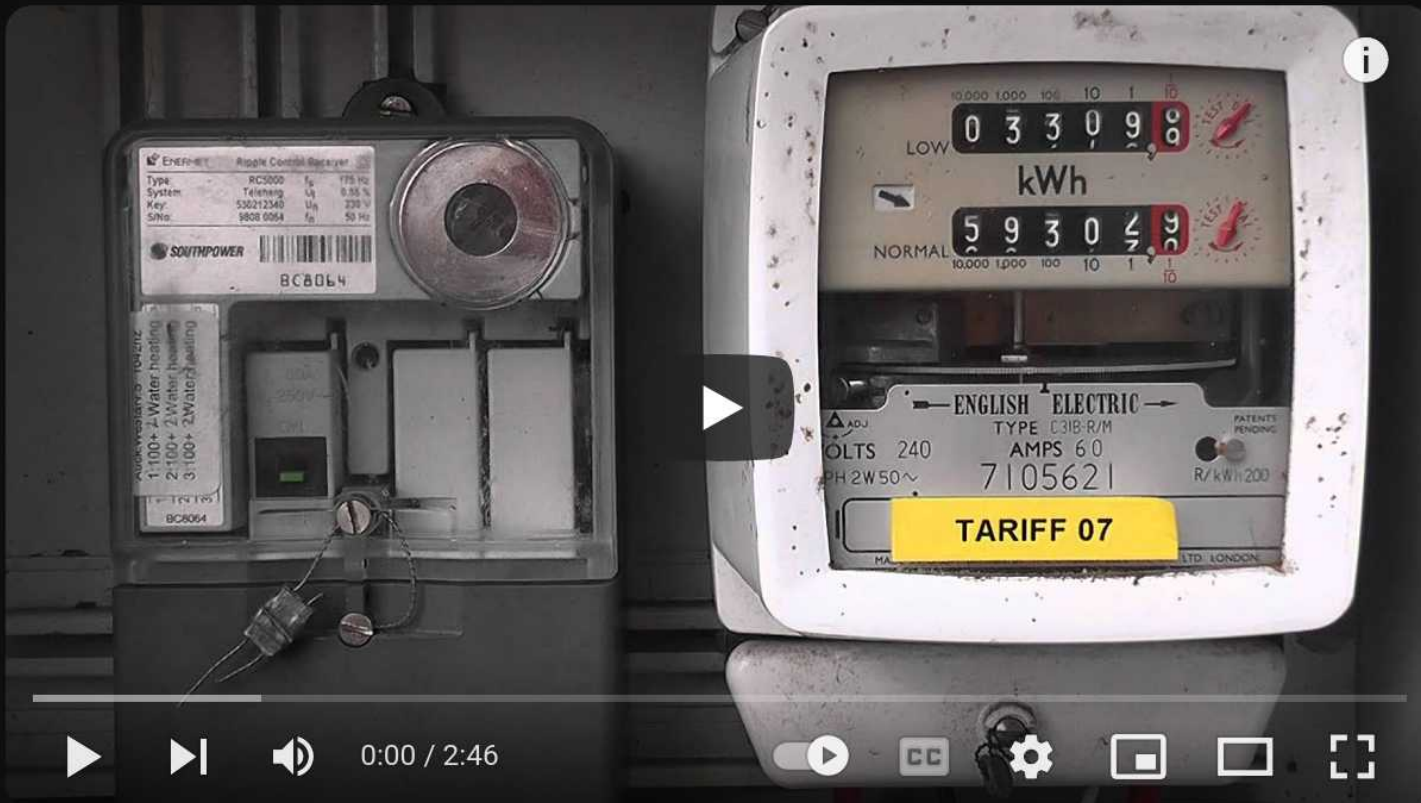
(a) EXAGGERATED

(b) ACTUAL



$\tau = \text{RHYTHM (IN RANGE FROM 1 SECOND - 0.09604 SECOND)}$

RYTHMATIC pulse system (Plessey NZ, circa 1970)



Ripple Relay Receiver

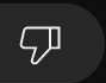


RODALCO2007

78.1K subscribers

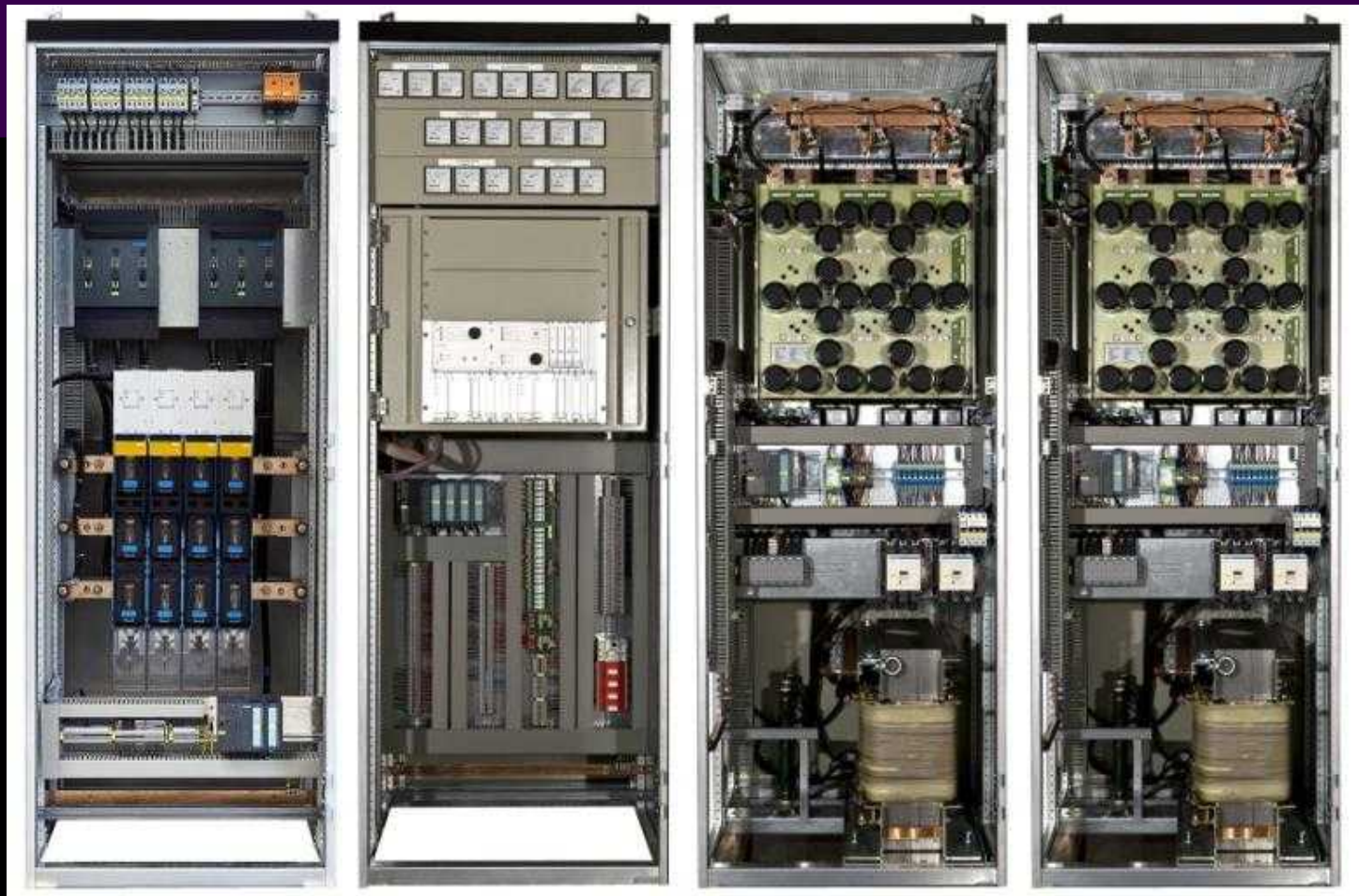
Subscribe

182



Share





**SKU: RTS640 Ripple Control
Transmitter**

Rundsteuersender für Mittelspannungsanlagen RTS600

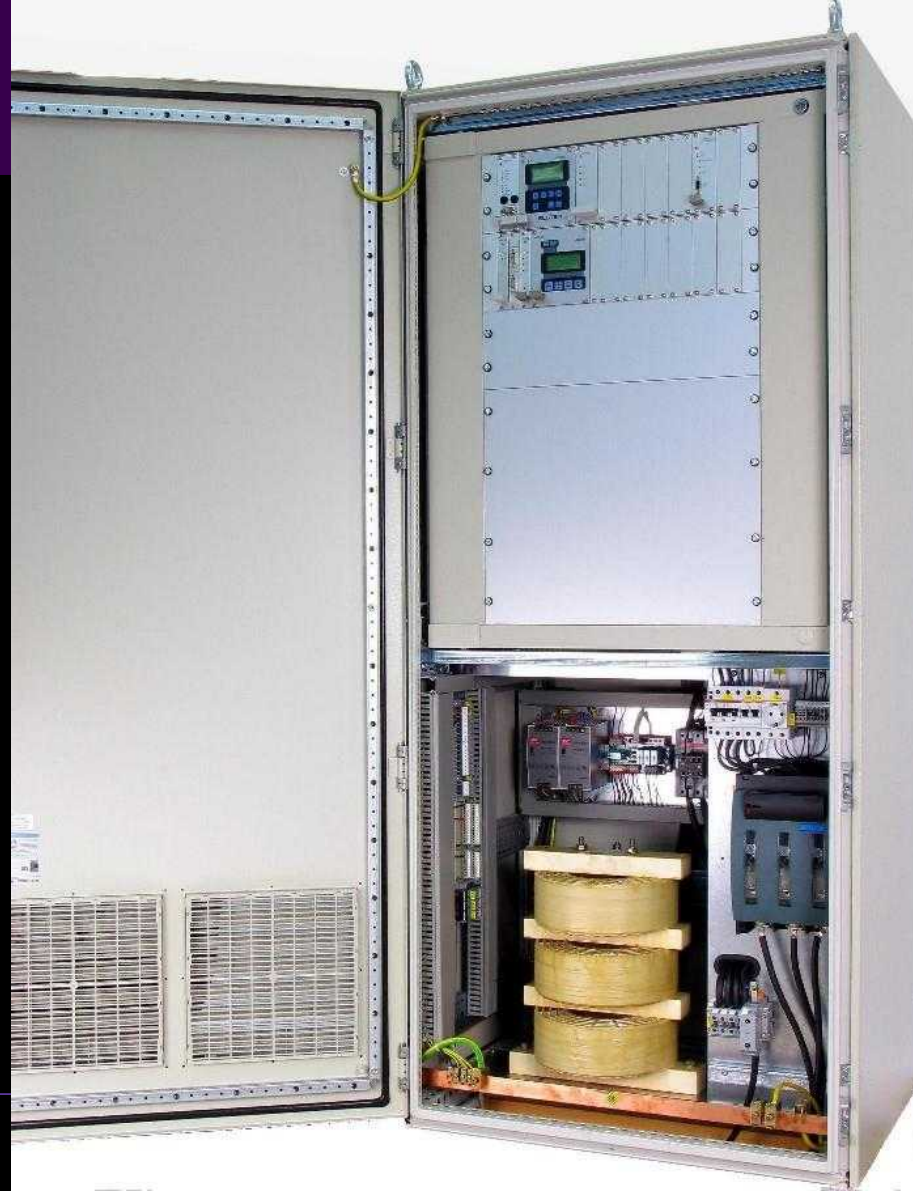
Der Rundsteuersender RTS 600 stellt die konsequente Weiterentwicklung des über ein Jahrzehnt weltweit erfolgreich eingesetzten Senders vom Typ RTS 500 dar.

Er verbindet dessen bewährte Funktionalität mit neuen technischen Komponenten sowie bedienerfreundlichen und –unterstützenden Eigenschaften, die standardmäßig bzw. optional verfügbar sind.

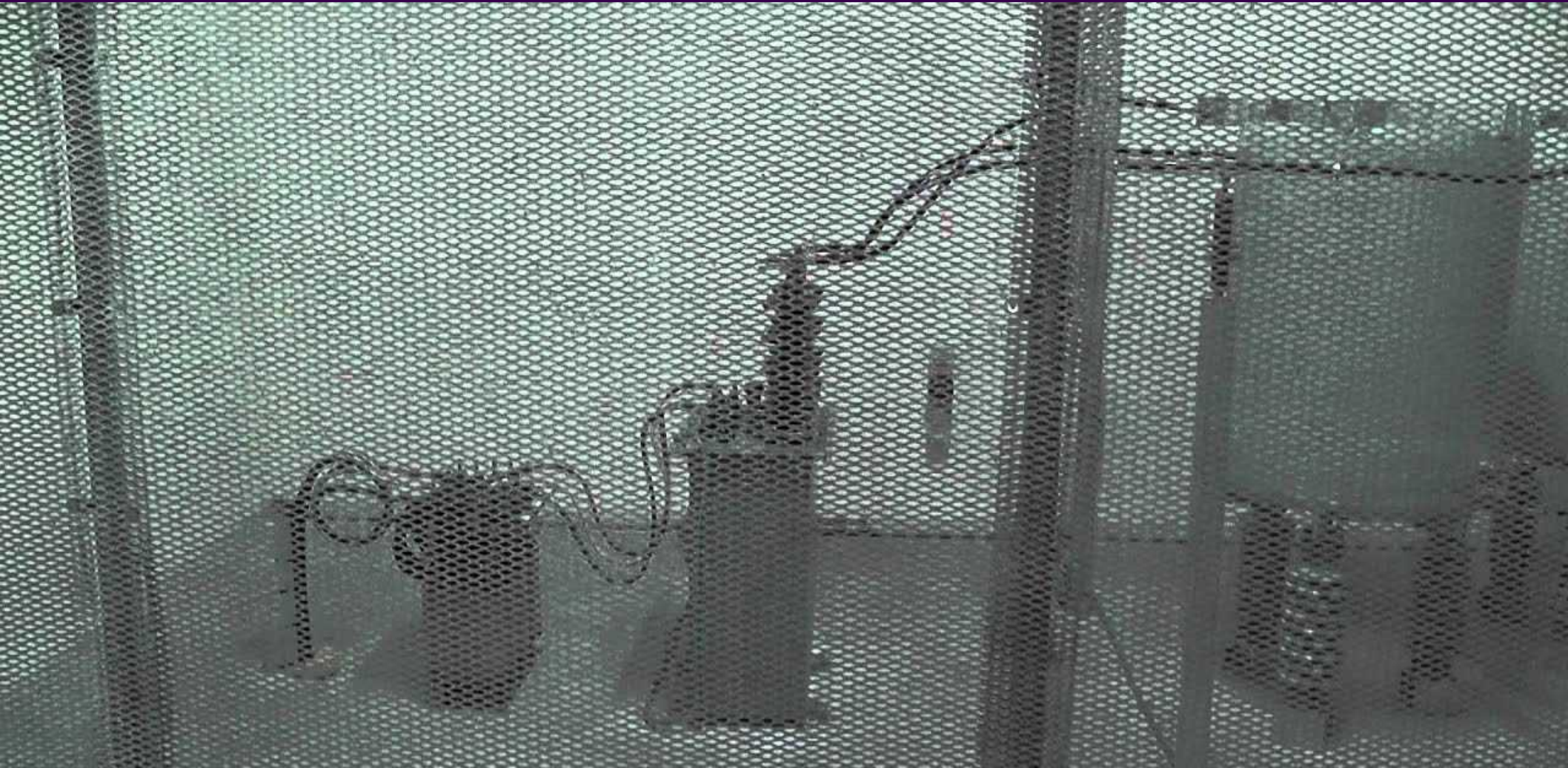


RTS600 mit Anpasskreis für
Parallelankopplung

11,000 Volts
20,000 Volts
30,000 Volts



22,000 Volts





Prefabricated Ripple Control Plant

Expandable and modular construction

Custom built, specialised prefabricated ripple control plant, that can either be used as a portable standby plant or used for fixed installation. This prefabricated plant is designed mounted in a transportable shipping container style building and built to be functional, durable and low in maintenance.

Built as a turnkey solution to meet with local AS/NZA Standards and Codes

[Catalogue](#)



MLL
MILLER
LUMBER
LUMBER

DANGER
DO NOT OPEN DOOR
UNLESS YOU ARE
PROPERLY TRAINED
AND EQUIPPED
TO DO SO

KENWORTH

Cantex

Cantex
COMMERCIAL
TRUCKS

Case Study

MOBILE RIPPLE CONTROL PLANT

For connection to Essential Energy's 11kV and 22kV grid



...they shut
down the load
until the signal
is disabled or
another
frequency signal
is received.



But that's pretty hardcore..

But that's pretty hardcore..

Or is it?

Transmitter SRS - Ripple Control

Expandable and modular construction

The Swistec Ripple Control Transmitter SRS is especially optimized for ripple-control tasks:

- Suitable for all types of coupling (parallel or series)
- Control unit and transmitter form a single unit
- Control, operation and supervision take place via a TCP/IP-connection
- The SRS transmitter can be synchronized with other transmitters
- To obtain the best possible reliability, redundant operation of two transmitters is possible, with automatic change-over in the event of a fault
- The SRS transmitter uses modular construction and has the following characteristics:
 - Output powers from 4kVA up to 400kVA
 - Future proof modular technology
 - Customer specific construction

What else is TCP/IP
connected to the grid?

What else is TCP/IP
connected to the grid?

Many, many things...

What else is TCP/IP
connected to the grid?

Many, many things...

Wh
co

Ma



d?

US Facts:

...first half of 2022

...solar installations
accounted for nearly..

40 percent of all new
electricity-generating
capacity..

added to the U.S. grid.

Who looks after Solar in US?

Who looks after Solar in US?

- Household owner

Who looks after Solar in US?

- Household owner
- Energy.gov



Who looks after Solar in US?

- Household owner
- Energy.gov
- Office of Cybersecurity, Energy Security, and Emergency Response



Who looks after Solar in US?

- Household owner
- Energy.gov
- Office of Cybersecurity, Energy Security, and Emergency Response
- NERC, NRCC, CISA, etc... FEMA?



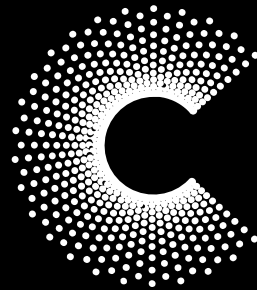
Who looks after Solar in AU?

Who looks after Solar in AU?

- **Clean Energy Regulator**
CER

Who looks after Solar in AU?

- Clean Energy Regulator
CER
- Clean Energy Council
CEC



**CLEAN
ENERGY
COUNCIL**

Who looks after Solar in AU?

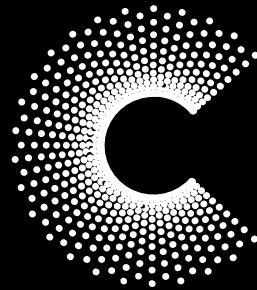
- Clean Energy Regulator

CER

- Clean Energy Council

CEC

- Until February 2024... the CEC is stepping down



**CLEAN
ENERGY
COUNCIL**

Why is this interesting?

Why is this interesting?

Household owners effectively
become the guardians of the
grid

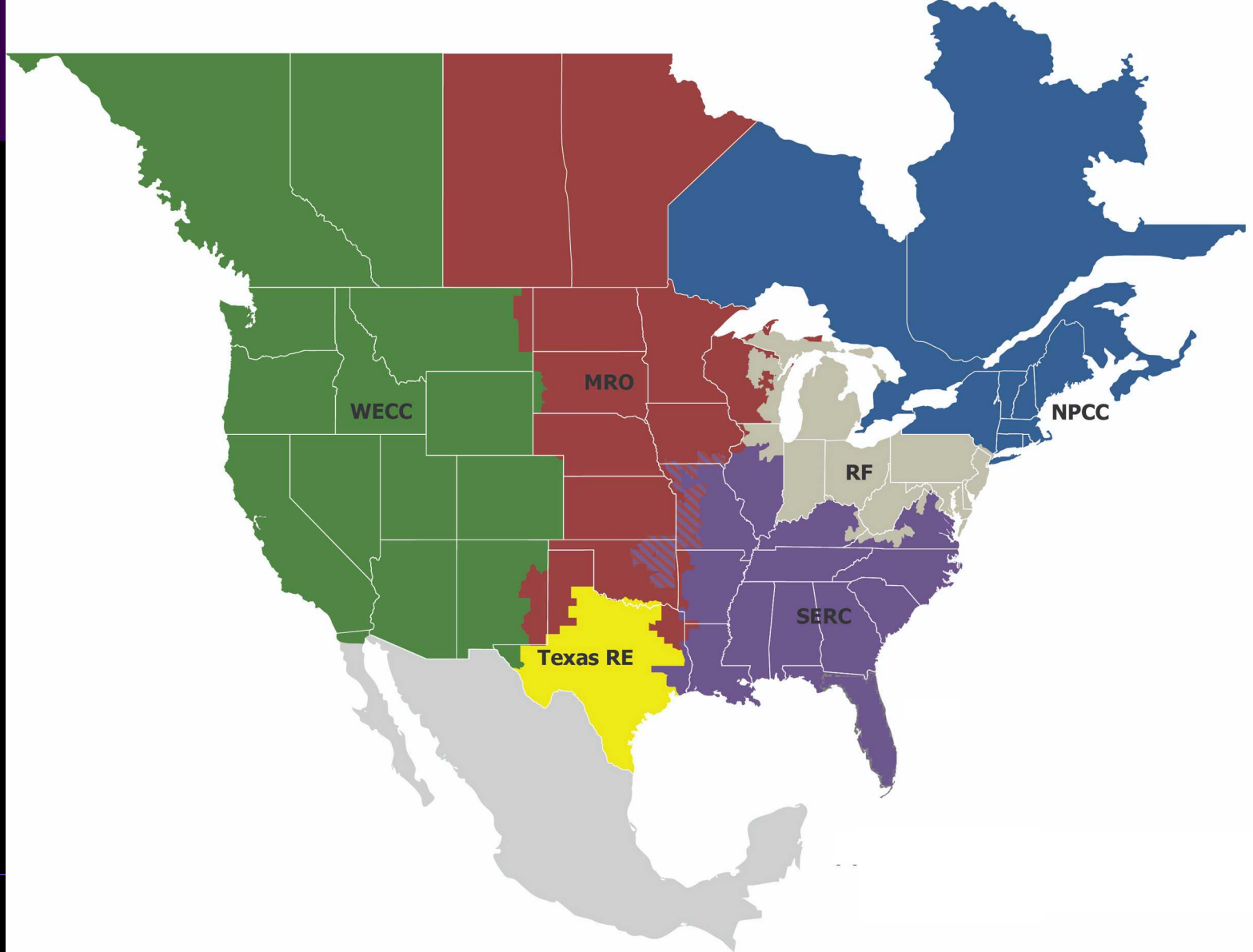
Why is this interesting?

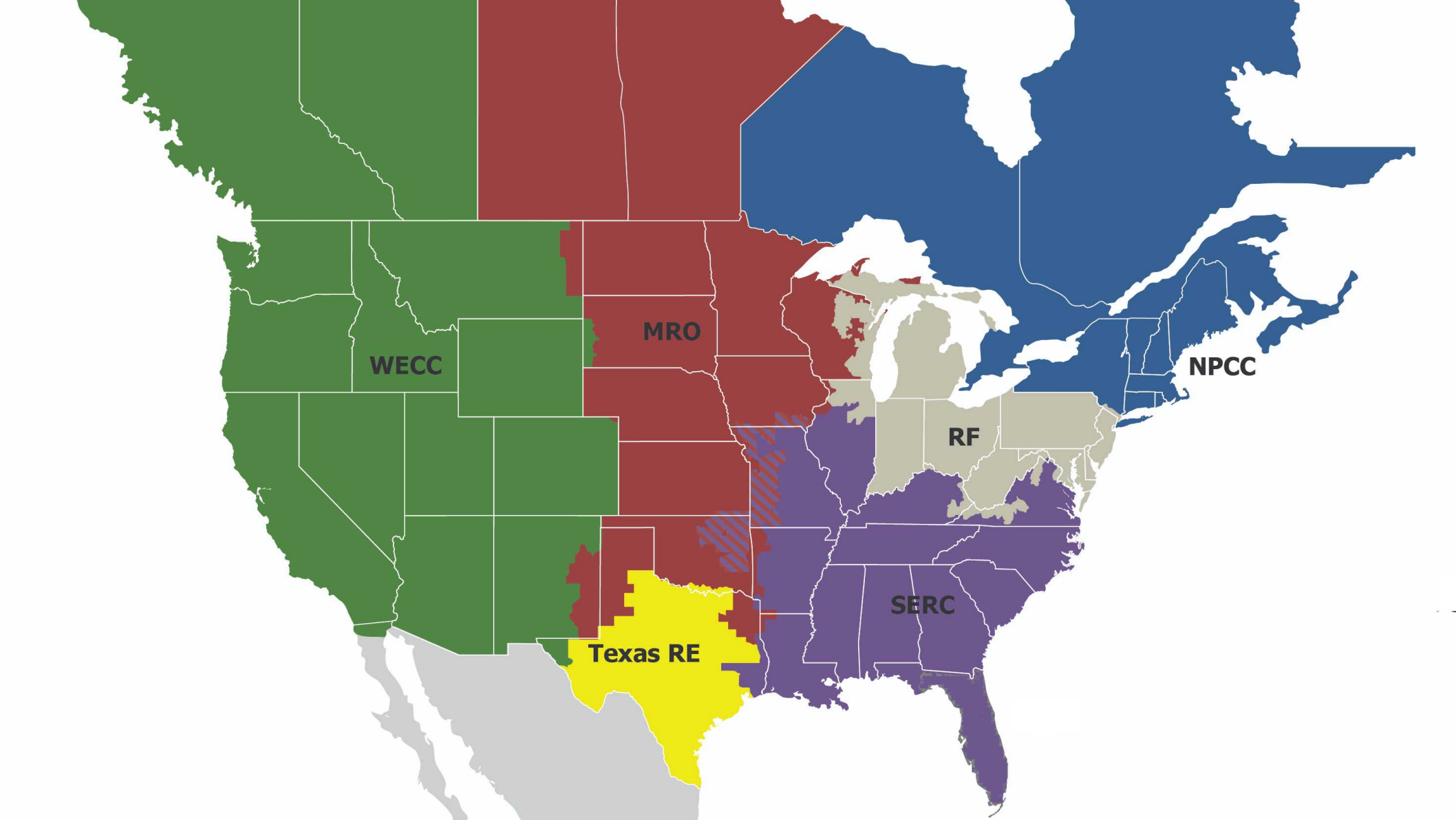
How
bec
gri



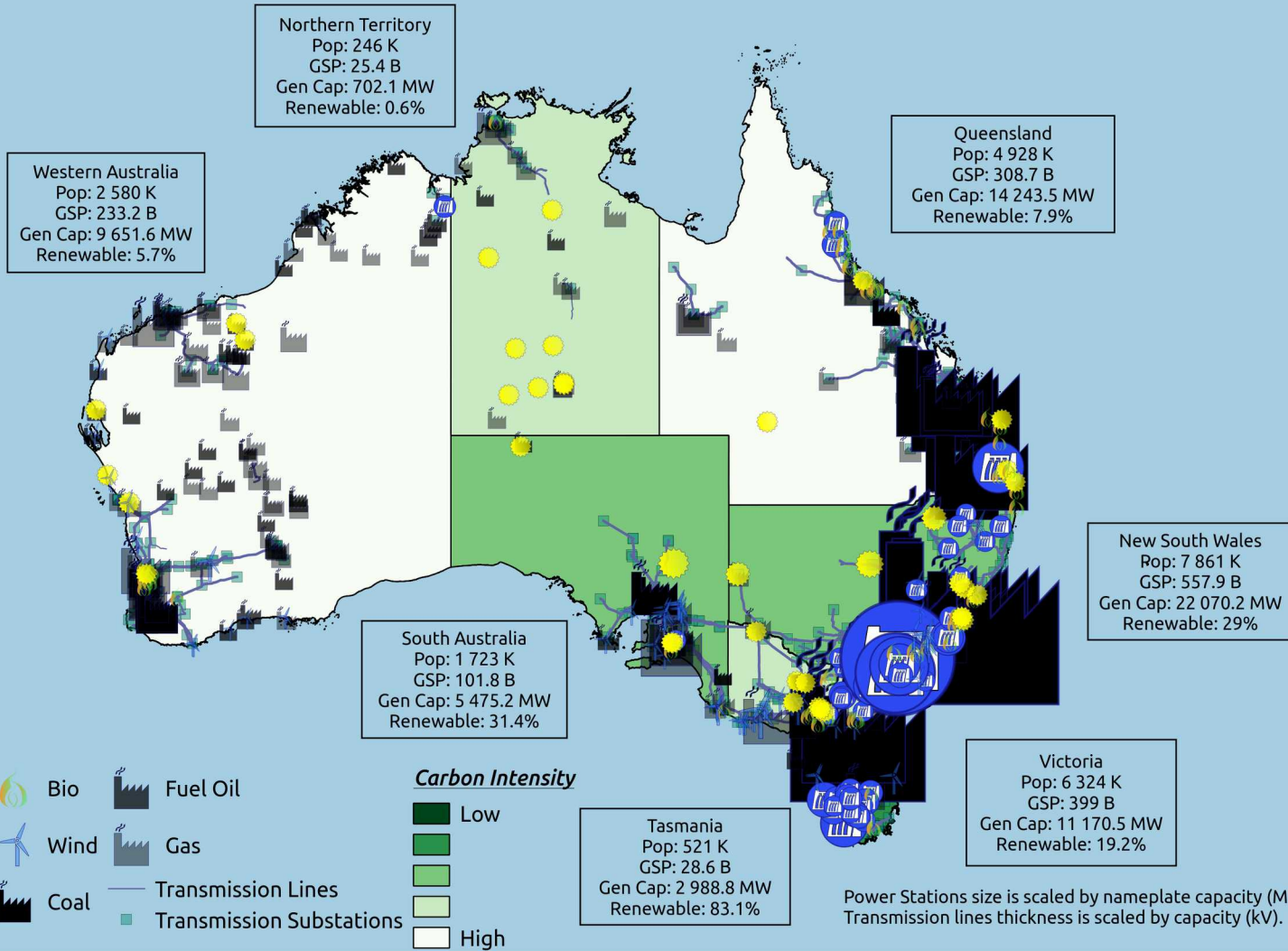
<https://survival-mastery.com/basics/family-survival-system.html>

US Grids





Australian National Grid

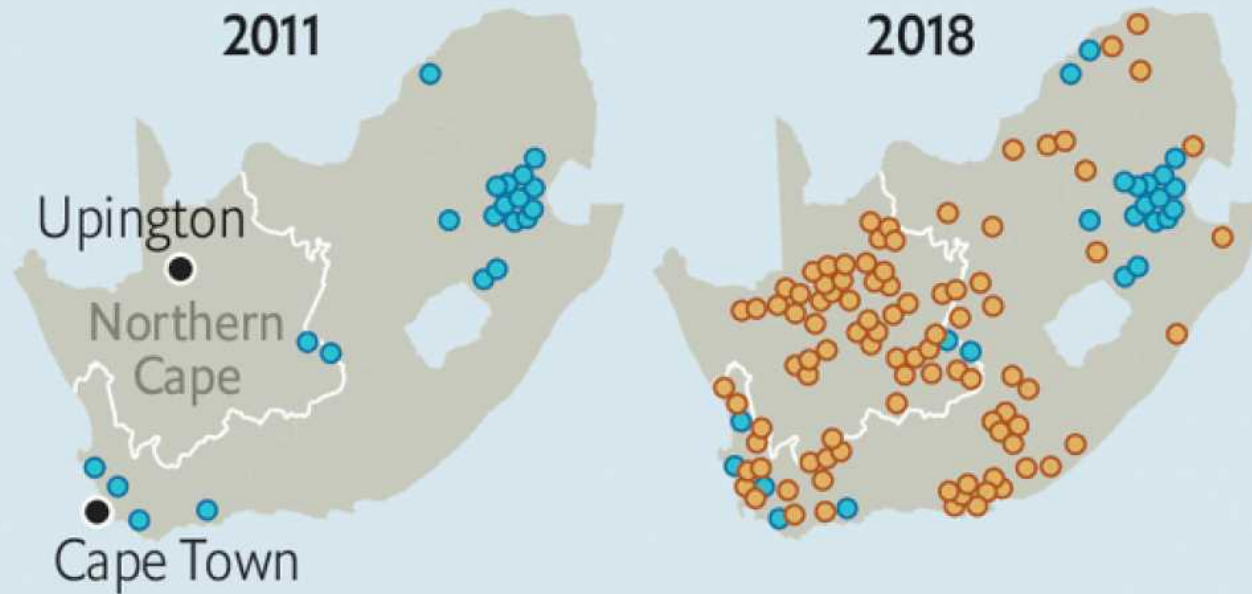


Power Stations size is scaled by nameplate capacity (MW).
Transmission lines thickness is scaled by capacity (kV).

Power to the people

South Africa, energy suppliers' power plants

● Eskom ● Independent power producer



Source: Power Futures Lab, UCT

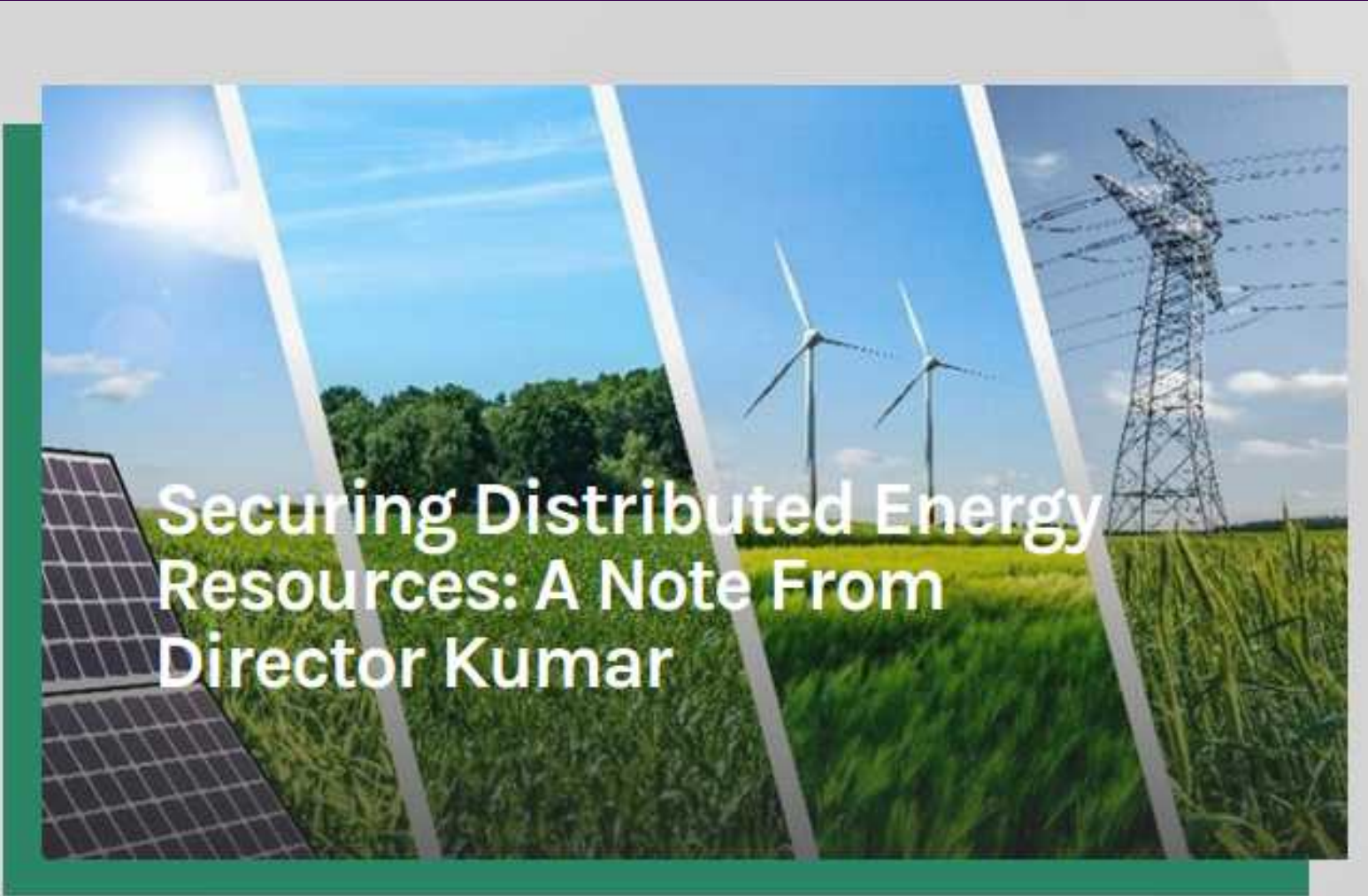
ZA

ENERGY.GOV



Office of
**CYBERSECURITY, ENERGY SECURITY, AND
EMERGENCY RESPONSE**

- **CESER**



Securing Distributed Energy Resources: A Note From Director Kumar

Facts:

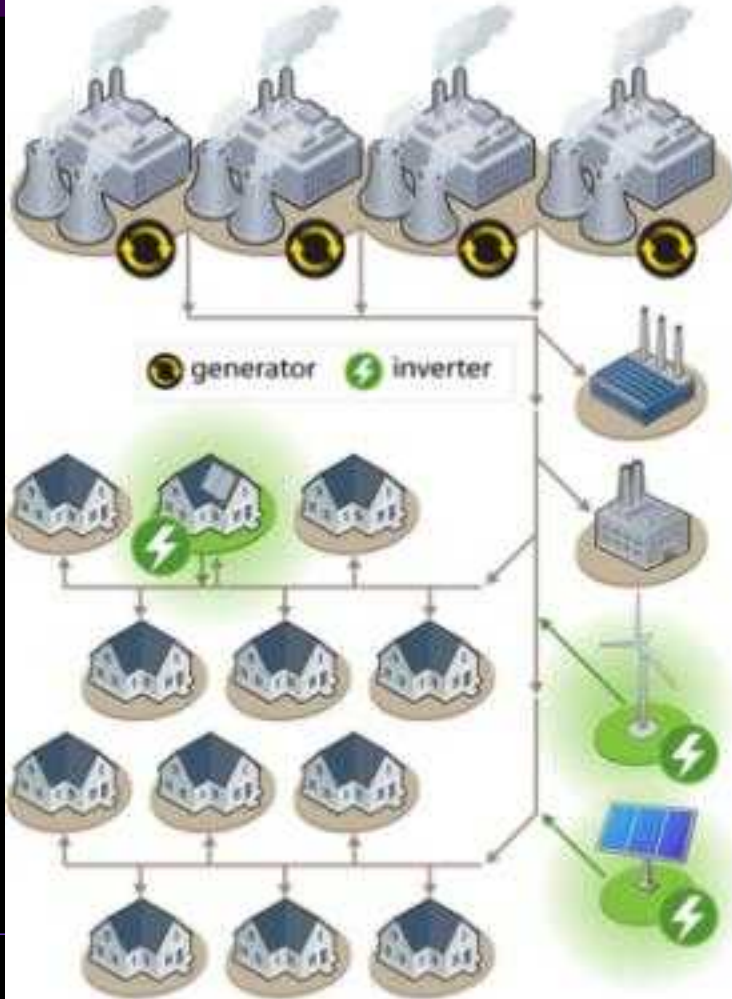
**Securing distributed grids is
clearly a priority**

Facts:

Securing distributed grids is clearly a priority

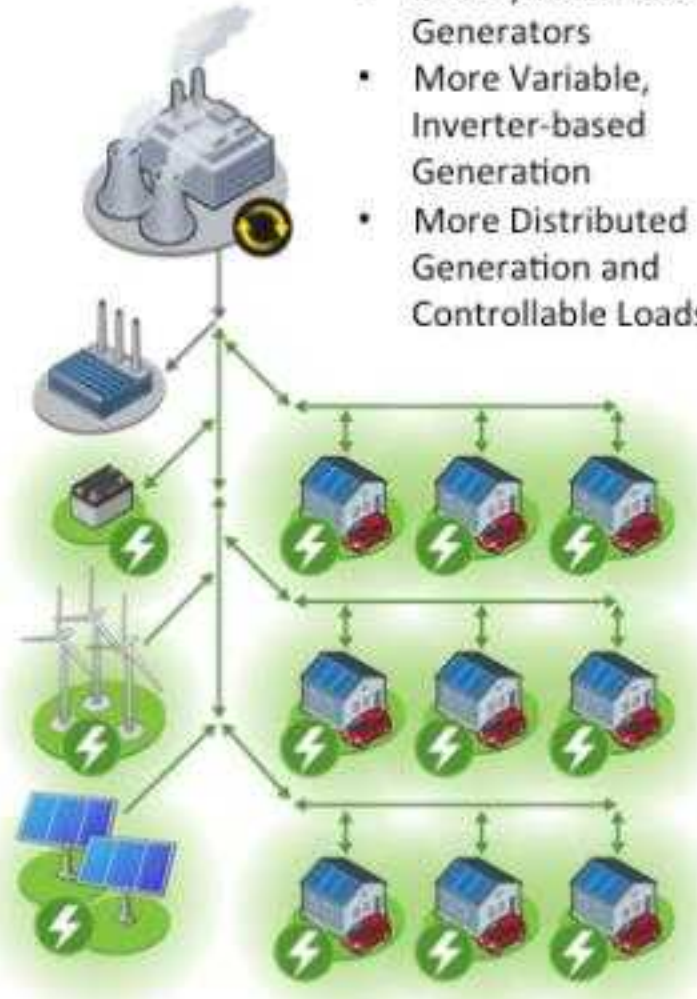
What is a distributed grid?

Present Grid



Future Grid

- Less Synchronous Generators
- More Variable, Inverter-based Generation
- More Distributed Generation and Controllable Loads



<https://www.osti.gov/pages/biblio/1660215>

What happens when
the power goes out?

What happens when
the power goes out?

What happens when Grid
Supply drops?



Google

🔍 what happens if you can't charge your tesla|



🔍 what happens if you can't charge your tesla

🔍 what happens if you charge your tesla to **100**

🔍 what if **i** can't charge **my** tesla **at home**

🔍 what happens if **i** leave **my** tesla **plugged in**

🔍 **how long** can you **go without charging** your tesla

Google Search

I'm Feeling Lucky

Report inappropriate predictions



what happens if you can't charge your tesla



Videos



Images



News



Shopping



Maps



Books



Flights



Finance

About 30,400,000 results (0.34 seconds)

If you're driving an electric car and it runs out of power, the short and simple answer is this: **the car will stop**—and you'll need to call roadside assistance to get towed to the nearest charging station.



GetJerry.com

<https://getjerry.com> > Questions

What happens if my Tesla runs out of battery? - Jerry



About featured snippets



Feedback

Cruise demo

Sooo...

- **During disasters**

Sooo...

- **During disasters**
- **Cell phone reception drops**

Sooo...

- **During disasters**
- **Cell phone reception drops**
- **Autonomous cars just stop**

Sooo

- D
- C
- A



What about electric
planes?



Electric Aviation Is Arriving, and **Cybersecurity** Is High Priority

NREL reviews the cybersecurity challenge of networked infrastructure at airports serving electrified aircraft >

Distributed Energy Resource Cybersecurity Framework Best Practices

Charisa Powell, Konrad Hauck, Anuj Sanghvi,
and Tami Reynolds




National Renewable Energy Laboratory

Powell, Charisa, Konrad Hauck, Anuj Sanghvi, and Tami Reynolds.
2020.

Distributed Energy Resource Cybersecurity Framework Best Practices.
Golden, CO: National Renewable Energy Laboratory. NREL/TP-5R00-
75921.

<https://www.nrel.gov/docs/fy20osti/75921.pdf>.

Table 1. DERC's Three Domains and Their Respective Subdomains Address a Comprehensive Set of Controls for Securing DER Technologies

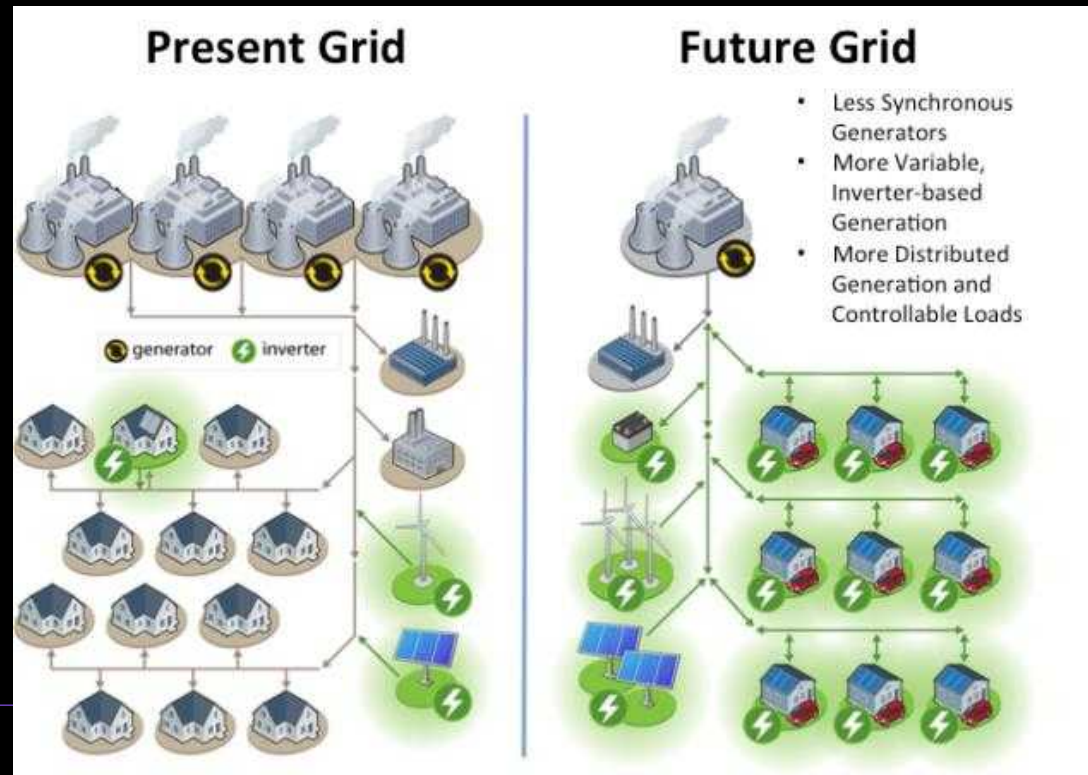
 Cyber Governance Security Assessment	 Cyber-Physical Technical Management Security Assessment	 Physical Security Assessment
<p>Domains:</p>	<p>Domains:</p>	<p>Domains:</p>
<ul style="list-style-type: none"> • Risk Management • Asset, Change, and Configuration • Identity and Access Management • Threat and Vulnerability Management • Situational Awareness • Information Sharing and Communication Management • Incident Response • External Dependency Management • Cybersecurity Program Management 	<ul style="list-style-type: none"> • Account Management <ul style="list-style-type: none"> - Role-Based Access Control - Anomalous behavior in system logs • Configuration Management <ul style="list-style-type: none"> - Access Restrictions - Configuration Settings - Configuration Change Control - Internal/External User Management • Systems/Device Management <ul style="list-style-type: none"> - Fail-Safe Procedures - Ports and Input/output Device Access - Cryptographic Protection - Software Integrity/Patch Management 	<ul style="list-style-type: none"> • Administration Controls <ul style="list-style-type: none"> - Audits - Holistic Security/Contingency Planning - Personnel Security Planning • Asset Controls <ul style="list-style-type: none"> - Equipment - Maintenance • Structure Controls <ul style="list-style-type: none"> - Distancing Practices for Sensitive Assets - Intrusion Detection/Prevention Assets - Response Teams/Force Protection

Required:

- **Force protection personnel:** Individual(s) responsible for on-site physical security needs, including physical enforcement of rules, incident response, and patrolling operations
- **Access control personnel:** Individual(s) responsible for badges, visitor controls, site visits from external personnel, locks, and keys
- **DER/OT/IT systems administrator:** A network/system administrator for the DER system (and beyond), responsible for managing accounts and system configuration
- **Emergency planning and management personnel:** Individual(s) responsible for planning, administrating, and disseminating important information around site-wide security matters
- **Physical security training personnel:** Individual(s) who work closely with emergency planning and management personnel to ensure policies, procedures, and drills are performed and all personnel on-site are aware of how to respond to site incidents
- **Compliance officer:** Individual(s) responsible for enforcing up-to-date standards relevant to DERs
- **Human resources personnel:** Sitewide team specifically assigned to administrative tasks related to employees
- **Systems/controls engineer:** Technical individual primarily working directly with control systems for research and/or operational purposes
- **Contracting personnel:** Individual(s) familiar with existing third-party agreements associated with the installation and operation of DERs.

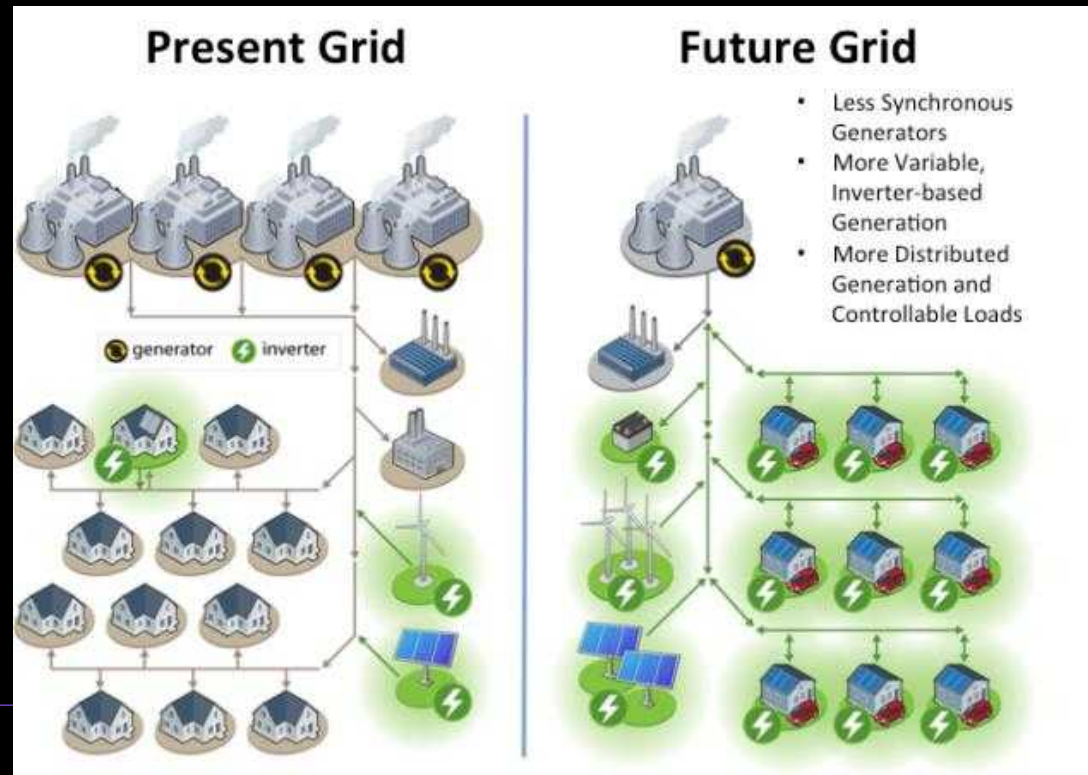
My opinion

- DER site personnel



My opinion

- DER site personnel is anyone who has a solar system



What *really* happens when the
power goes out?

STAGE 4 ROLLING BLACKOUTS IMPLEMENTED UNTIL 05H00 SATURDAY MORNING

14:17 CAT

STAGE 4 ROLLING BLACKOUTS



@SATODAY_SABC

<https://www.youtube.com/watch?v=9K8paP0fuoc>

14:21 CAT LIVE

STAGE 4 ROLLING BLACKOUTS



14:21 CAT LIVE

STAGE 4 ROLLING BLACKOUTS



© 2014 CATV 10.5

14:21 CAT

STAGE 4 ROLLING BLACKOUTS

CONTINUED



14:21 CAT

STAGE 4 ROLLING BLACKOUTS



pull up for precise seeking



Impact on small businesses

8:49

14:22 CAT LIVE

STAGE 4 ROLLING BLACKOUTS



Full screen (f)

@SATODAY SABC

What *really* happens when the power goes out?

What **really** happens when the power goes out?

- Electric cars stop charging

What **really** happens when the power goes out?

- Electric cars stop charging
- Water stops pumping

What **really** happens when the power goes out?

- Electric cars stop charging
- Water stops pumping
- Refrigerator motors stop

What **really** happens when the power goes out?

- Electric cars stop charging
- Water stops pumping
- Refrigerator motors stop
- Air conditioner motors stop

What **really** happens when the power goes out?

- Electric cars stop charging
- Water stops pumping
- Refrigerator motors stop
- Air conditioner motors stop
- Data centers die

What **really** happens when the power goes out?

- Electric cars stop charging
- Water stops pumping
- Refrigerator motors stop
- Air conditioner motors stop
- Data centers die
- Cashless payments stop

Ready.gov recommends:

- Throw away **any** food that has been exposed to temperatures 40 degrees or higher for **two hours or more**

The screenshot shows the Ready.gov website interface. At the top, there is a navigation bar with links: Disasters and Emergencies, Make a Plan, Get Involved, Ready Business, Ready Kids, and Resources. Below this is the Ready.gov logo, which includes a green checkmark icon and the text 'Ready'. To the right of the logo are social media icons for Facebook, Twitter, and YouTube, along with a 'Contact Ready' link. The main content area has a green background. On the left, there is a section for 'Ready.gov' with the U.S. Department of Homeland Security logo and the text 'An official website of the U.S. Department of Homeland Security'. Below this are three columns of links: Accessibility, Accountability, Careers, Contact Us, FOIA, Glossary, No FEAR Act, Plug-Ins, Privacy, Report Disaster Fraud, Website Information, DHS.gov, USA.gov, and Inspector General. On the right, there is a blue box for the National Terrorism Advisory System (NTAS) Bulletin, with the text 'BULLETIN READ MORE' and a link to 'Put this widget on your web page'.

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OPINION | REVIEW & OUTLOOK

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Maui's Fires and the Electric Grid

Utilities are spending more on the green energy transition than on resilience.

By The Editorial Board [Follow](#)

Aug. 18, 2023 7:01 pm ET

<https://www.wsj.com/articles/maui-fires-electric-grid-hawaiian-electric-green-energy-2b2c1399>

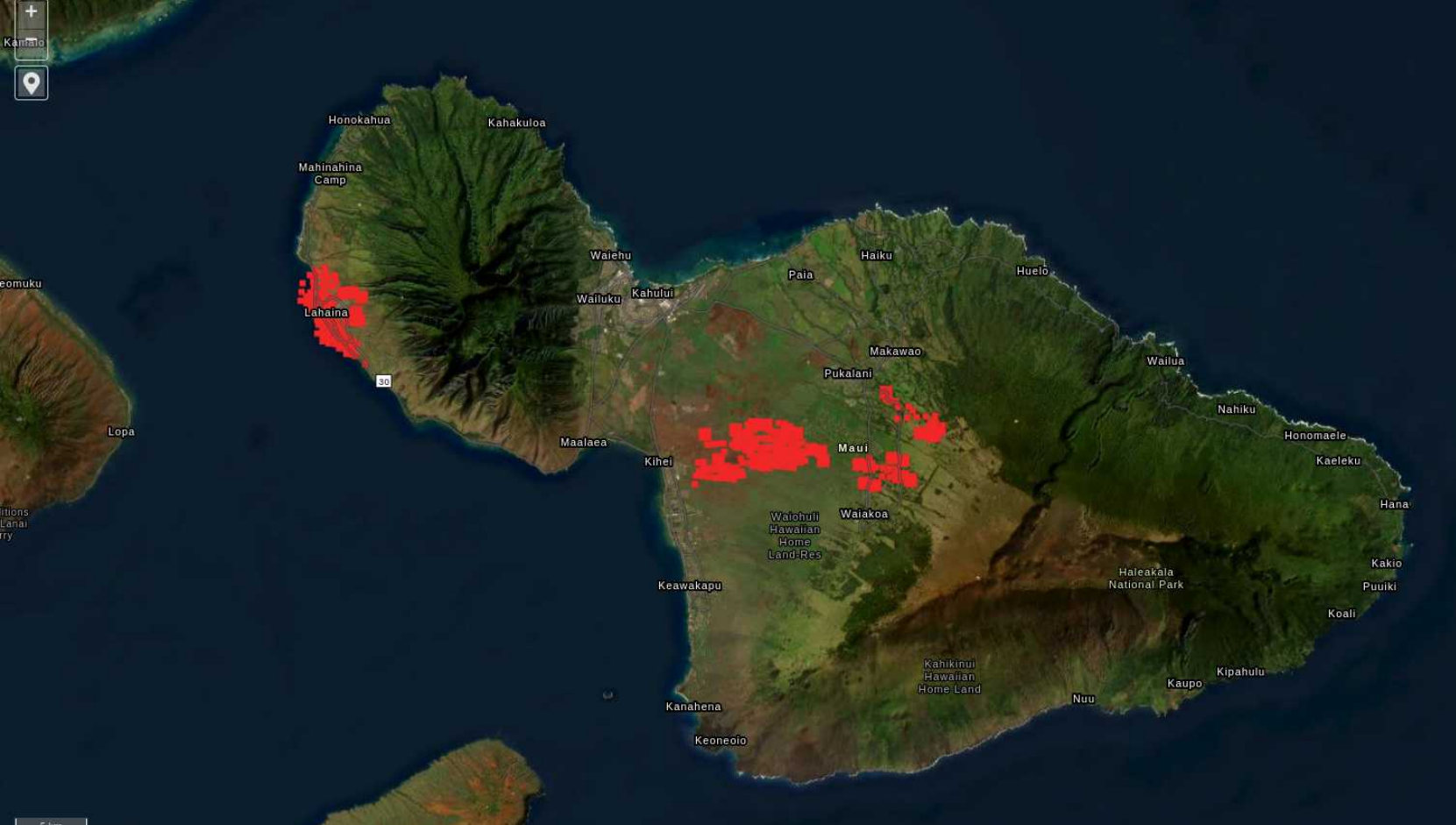
Maui Tragic Fires

- **Warning: Current Event, not to be taken as fact.**

Maui Tragic Fires



Lat: 20.458°, Lon: -155.704° Fires: Aug 09 2023 .. Aug 10 2023



CURRENT
HISTORICAL
✕

📅 Aug 10 2023
📅 2 days

BASIC MODE
ADVANCED MODE

Fires / Hotspots
ⓘ -

Simple
Time Based

- Landsat ⓘ
- VIIRS (S-NPP & NOAA-20) ⓘ
- MODIS (Aqua & Terra) ⓘ

Active Alerts
-

- USA Active Fire AVAILABLE
2023-08-16 - present
- Canada Active Fire AVAILABLE
2023-08-16 - present
- USA Fire Perimeter

Overlays
+

Dynamic Imagery
-

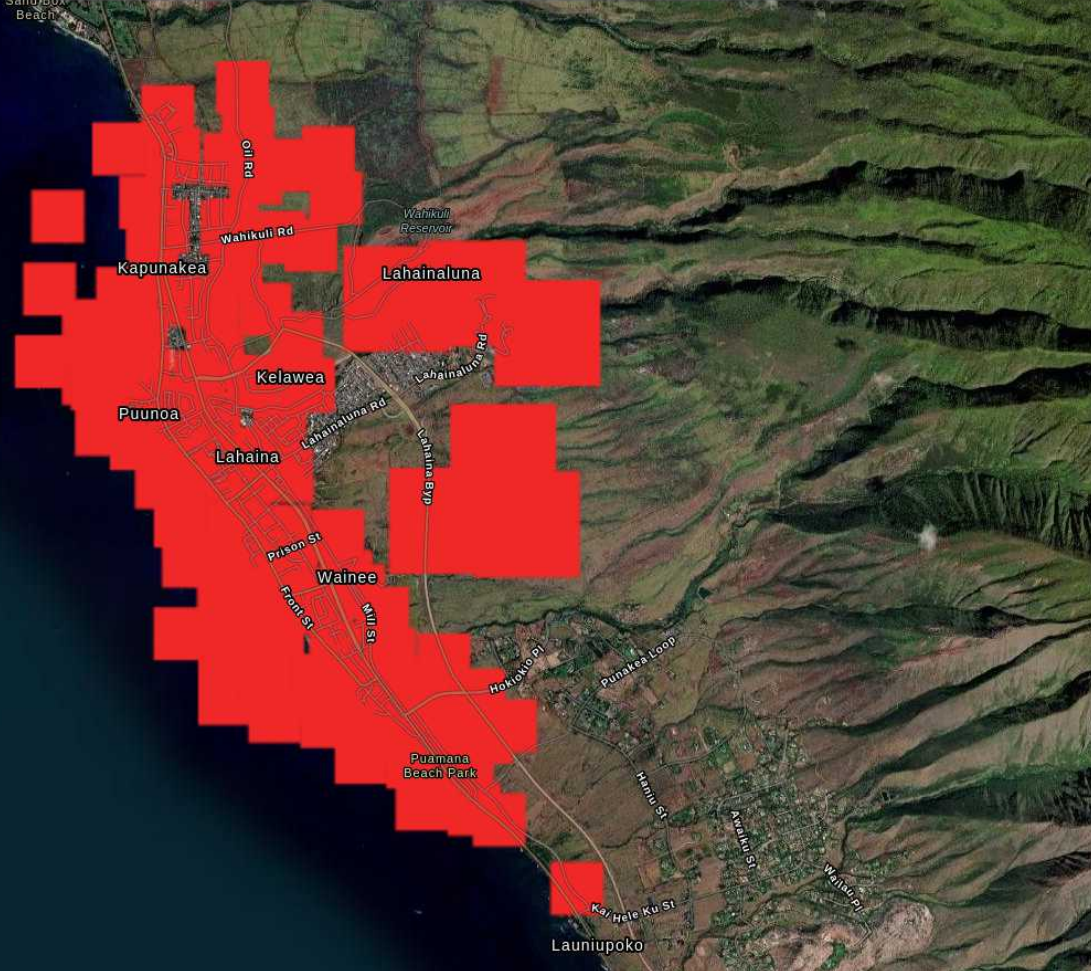
- NOAA-20 VIIRS NOAA-20 Corrected Reflectance (true color)
- S-NPP VIIRS S-NPP Corrected Reflectance (true color)
- AQUA MODIS/Aqua Corrected Reflectance (true color)
- TERRA MODIS/Terra Corrected Reflectance (true color)

Static Backgrounds
-

- Blue Marble

https://firms.modaps.eosdis.nasa.gov/usfs/map/#t:adv;d:2023-08-09..2023-08-10;l:landsat,noaa20-viirs,viirs,modis_a,modis_t,countries;@-156.3,20.7,10.4z

Lat: 20.836° Lon: -156.592° Fires: Aug 09 2023 - Aug 10 2023



CURRENT **HISTORICAL** ✕

📅 Aug 10 2023 📅 2 days ⌵

BASIC MODE **ADVANCED MODE**

Fires / Hotspots ⓘ —

Simple **Time Based**

- Landsat ⓘ
- VIIRS (S-NPP & NOAA-20) ⓘ
- MODIS (Aqua & Terra) ⓘ

Active Alerts —

- USA Active Fire: AVAILABLE 2023-08-16 - present ⊕ ⓘ
- Canada Active Fire: AVAILABLE 2023-08-16 - present ⊕ ⓘ
- USA Fire Perimeter ⊕ ⓘ

Overlays +

Dynamic Imagery —

- NOAA-20 VIIRS NOAA-20 Corrected Reflectance (true color) ⊕ ⓘ
- S-NPP VIIRS S-NPP Corrected Reflectance (true color) ⊕ ⓘ
- AQUA MODIS/Aqua Corrected Reflectance (true color) ⊕ ⓘ
- TERRA MODIS/Terra Corrected Reflectance (true color) ⊕ ⓘ

Static Backgrounds —

- 🌍 Blue Marble ⓘ
- 🗺️ Streets ⓘ

1000 m
2000 ft



Sign in

Hawaiian Traditions Tours

WILLIAMS HANDYMAN...

Maui Garden Oasis
Bright, homey B&B with a tropical garden

Leialii Pkwy

Leialii Pkwy

Wahinoho Way

W Aipuni Pl

Ainakea Pl

Hoolii St

Aa Pl

Hanohano St

Aipuni St

Aipuni St

Aipuni St

Aipuni St

E Aipuni Pl

Ainakea Rd

Aa Pl

Kaniau Rd

Kaniau Rd

Kaniau Rd



Google



Sign in

Aipuni St

Aipuni St

Aipuni St

Aipuni St

Ainakea Rd

Ainakea Rd

58

64

72

78

84

92

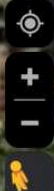
100



Layers

Google

156.3, 20.7, 10.4z



Sign in

Hyatt Residence Club
Maui, Kaanapali Beach
4.6 ★ (3647)
3-star hotel

Pau Huakai
American

Doctors On Call Maui
Urgent Care Center
Temporarily closed

Hertz Car Rental - Maui,
Kaanapali-lahaina...

Accents Hyatt
Regency Maui
Gift shop

Hyatt Regency Maui
Resort And Spa
4.5 ★ (4232)
4-star hotel

Grotto Bar
Temporarily closed

Son'z Steakhouse
Temporarily closed

ChargePoint
Charging Station

Drums of the
Pacific Lū'au
Resort Hawaiian performance & buffet

Moana Athletic Club

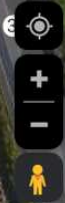
Lahaina Canoe Club
Hanakao Cemetery

30

KWP I & II
Temporarily closed



Google



Steakhouse
temporarily closed



ChargePoint
Charging Station

Google

ers

ālanapali Bc

Maui Tragic Fires

- Very challenging road ahead
- Monumental rebuild project

What is
catastrophic
failure?





Snow damaged 30 MW of PV systems in Japan in 2018-21 period





"ALAMO 2" SOLAR FARM DAMAGED BY HAIL

67°

10:15

**EYEWITNESS
NEWS**

RENTAL CAR SHORTAGE

FIRST ALERT

GIRLS KIDNAPPED

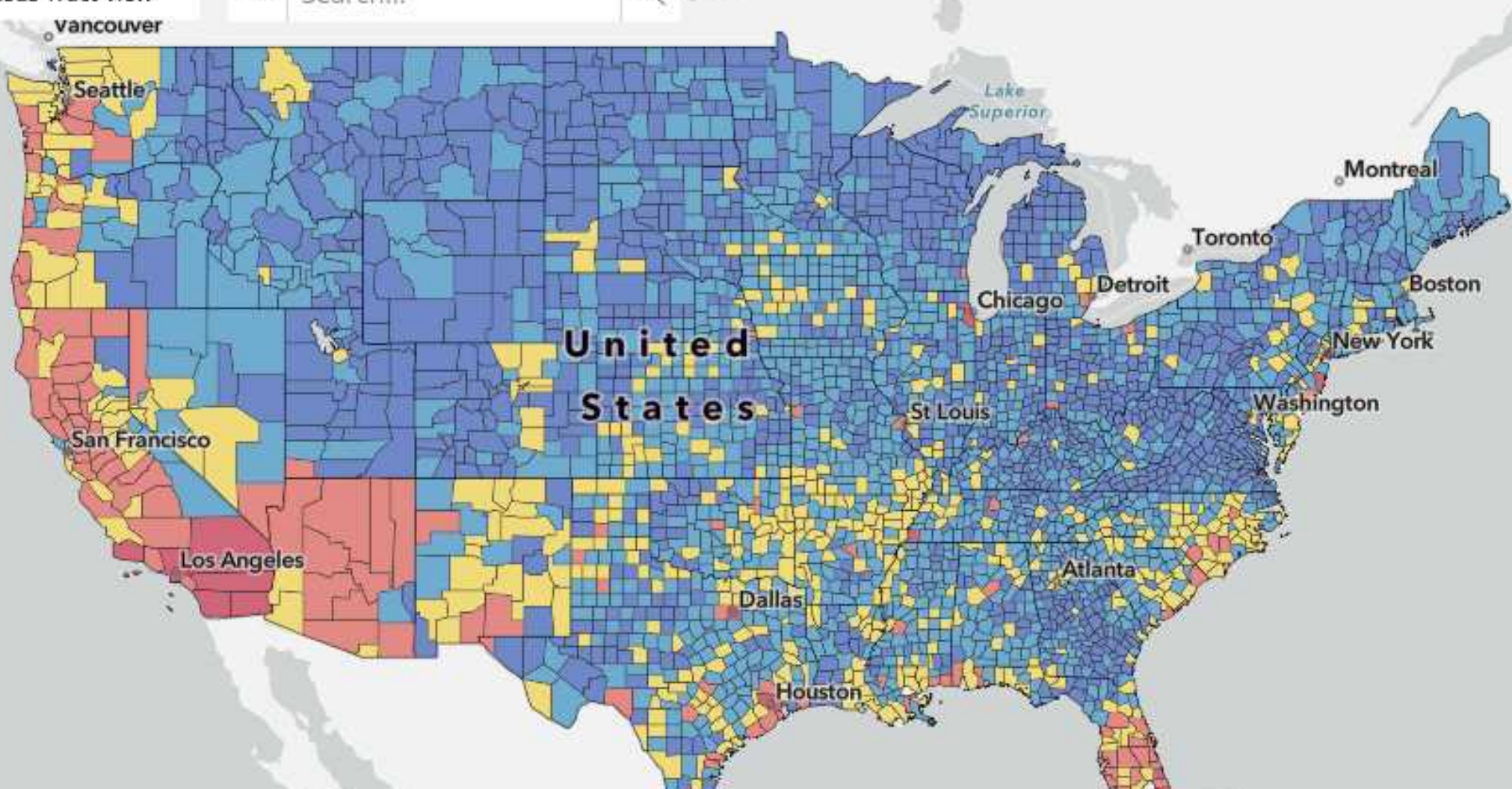


Solar Photovoltaics in Severe Weather: Cost Considerations for Storm Hardening PV Systems for Resilience

James Elsworth and Otto Van Geet

National Renewable Energy Laboratory

FEMA Risk Tool

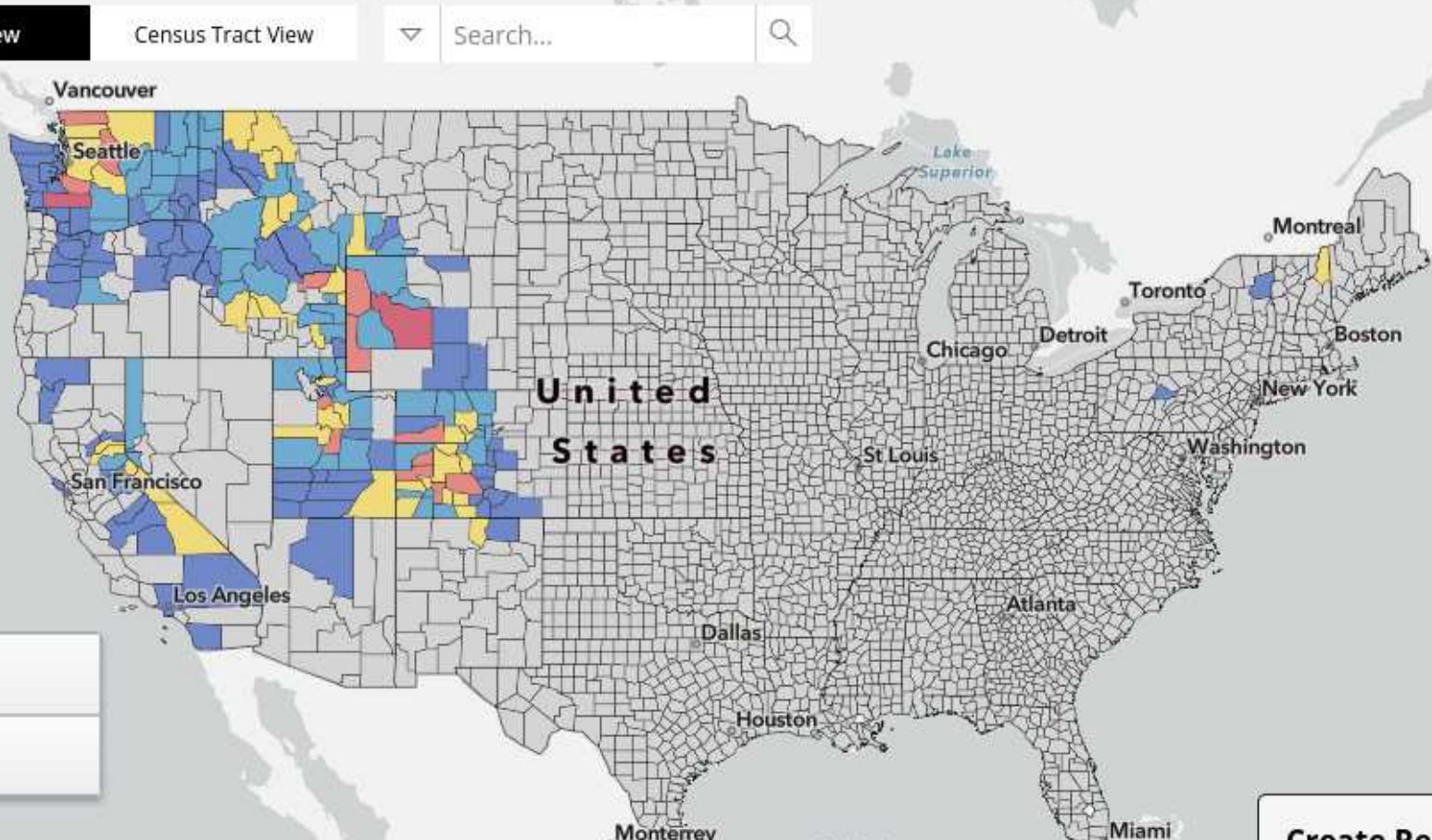


Avalanches

Avalanche (RI) | Expected Annual Loss | Social Vulnerability | Community Resilience

County View | Census Tract View | Search...

+
-
Home
Refresh

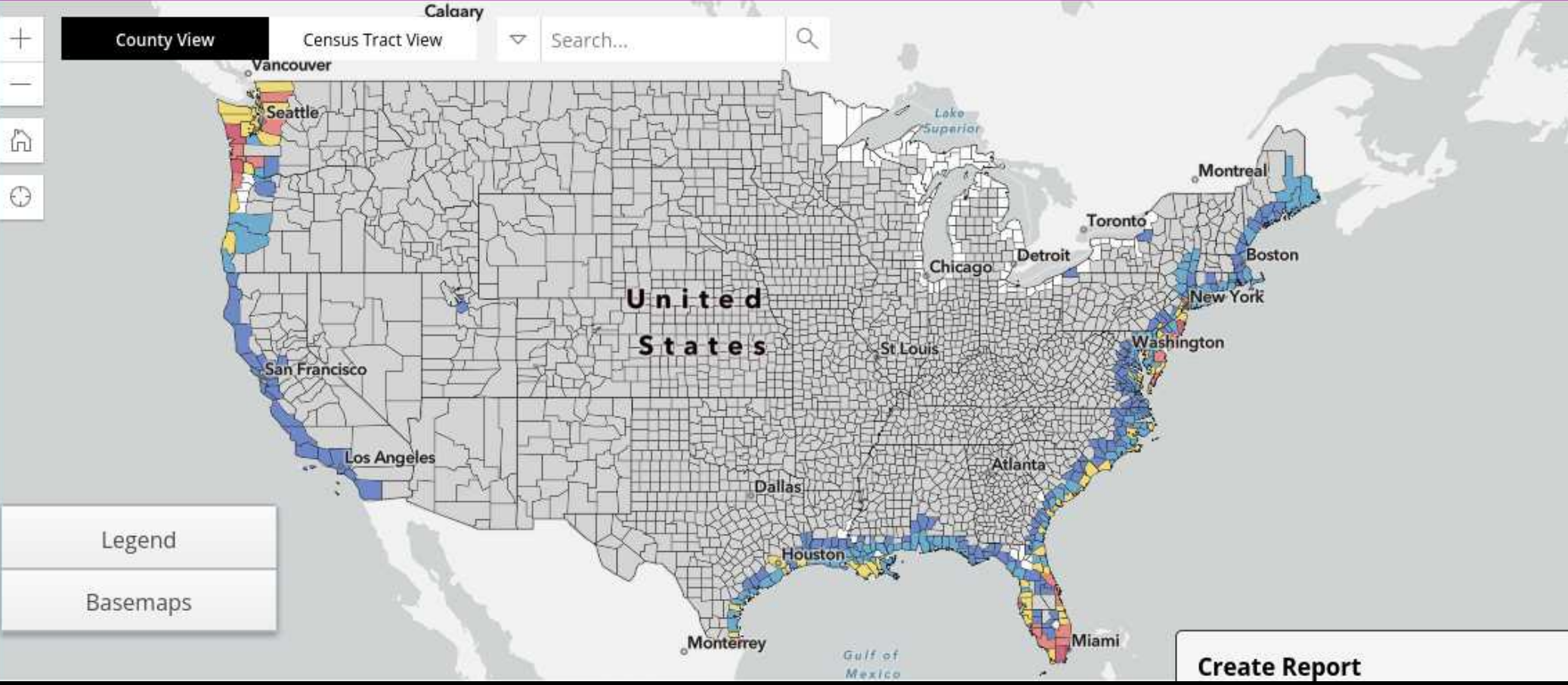


Legend
Basemaps

Create Report

Coastal Flooding

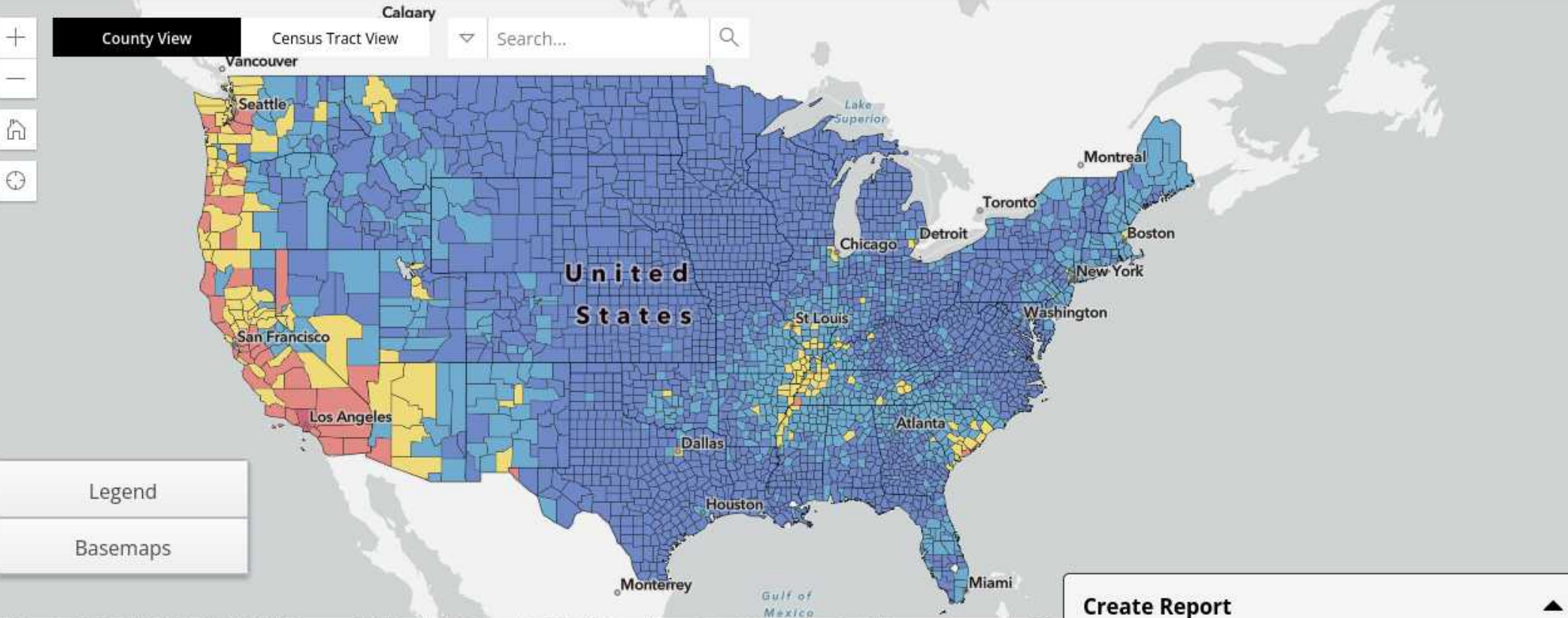
Coastal Flooding (RI) ▾ Expected Annual Loss ▾ Social Vulnerability Community Resilience



Earthquakes (High Impact)

Earthquake (RI) Expected Annual Loss Social Vulnerability Community Resilience

Help



Create Report

Hail (Med-High Impact)



FEMA

National Risk Index



Explore the Map

Learn More

Take Action

Get

Hail (RI)

Expected Annual Loss

Social Vulnerability

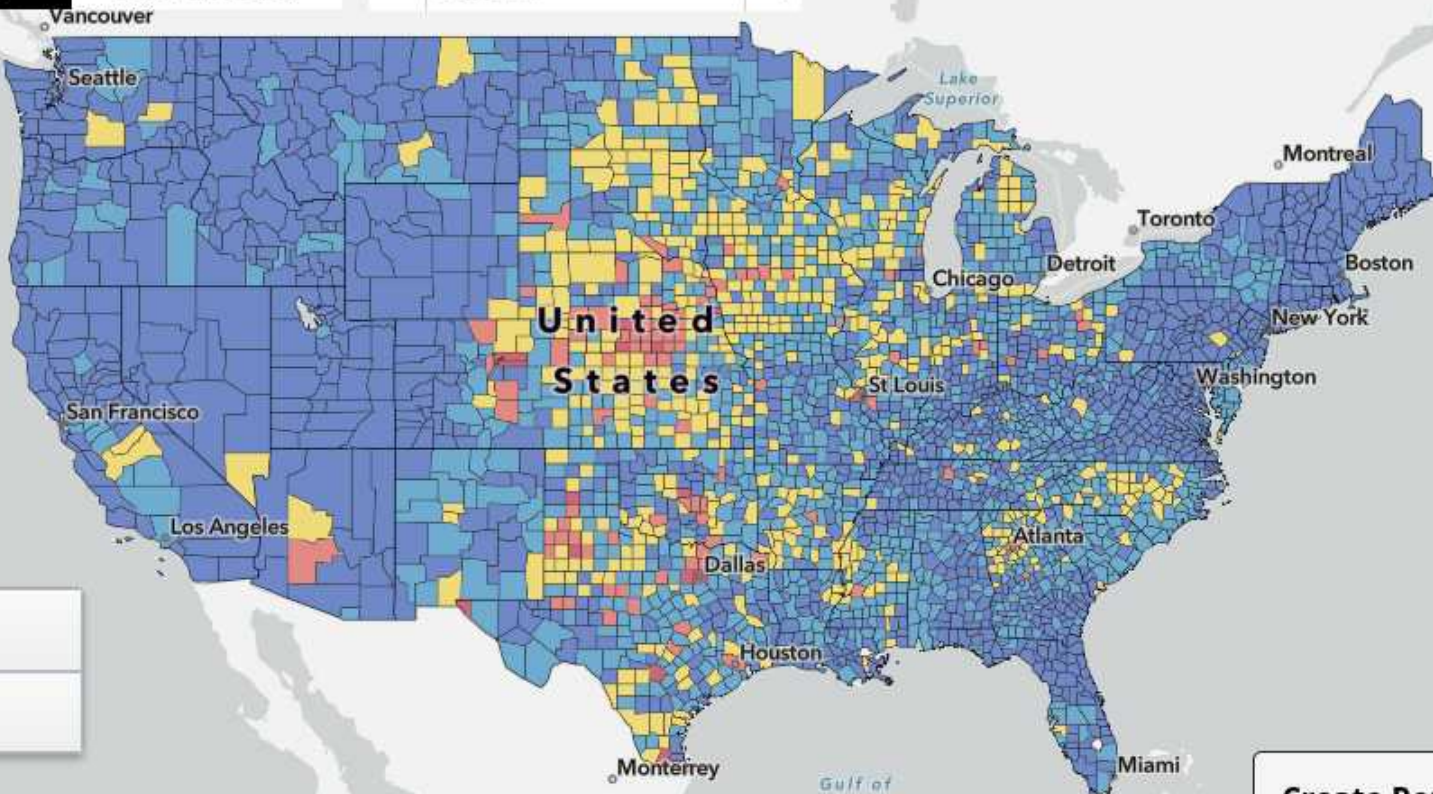
Community Resilience

Calgary

County View

Census Tract View

Search...



Legend

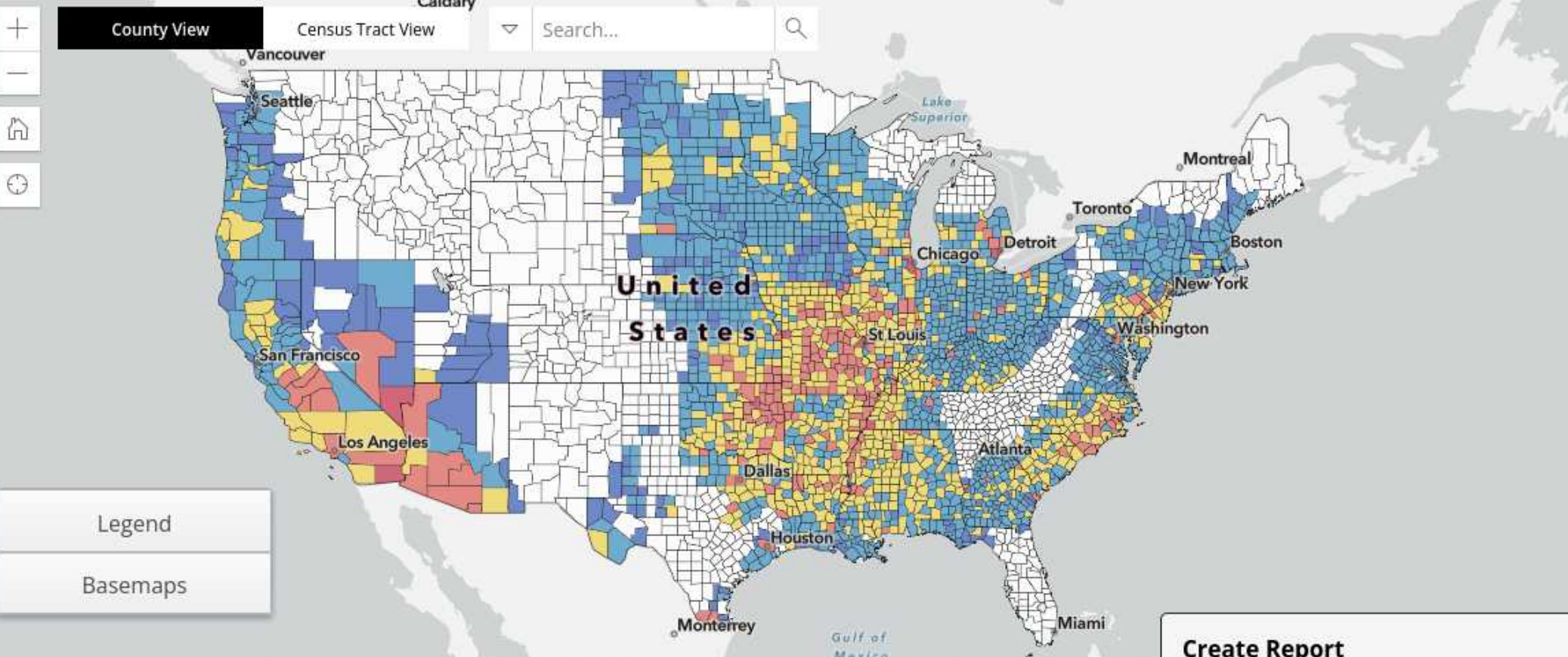
Basemaps

Create Report

Heat Wave (OK for Solar)

- Heat Wave (RI) ▾
- Expected Annual Loss ▾
- Social Vulnerability
- Community Resilience

County View | Census Tract View ▾ | Search... 🔍



Legend

Basemaps

Create Report

Hurricane (Extreme Impact)



FEMA

National Risk Index



Explore the Map

Learn More

Take Action

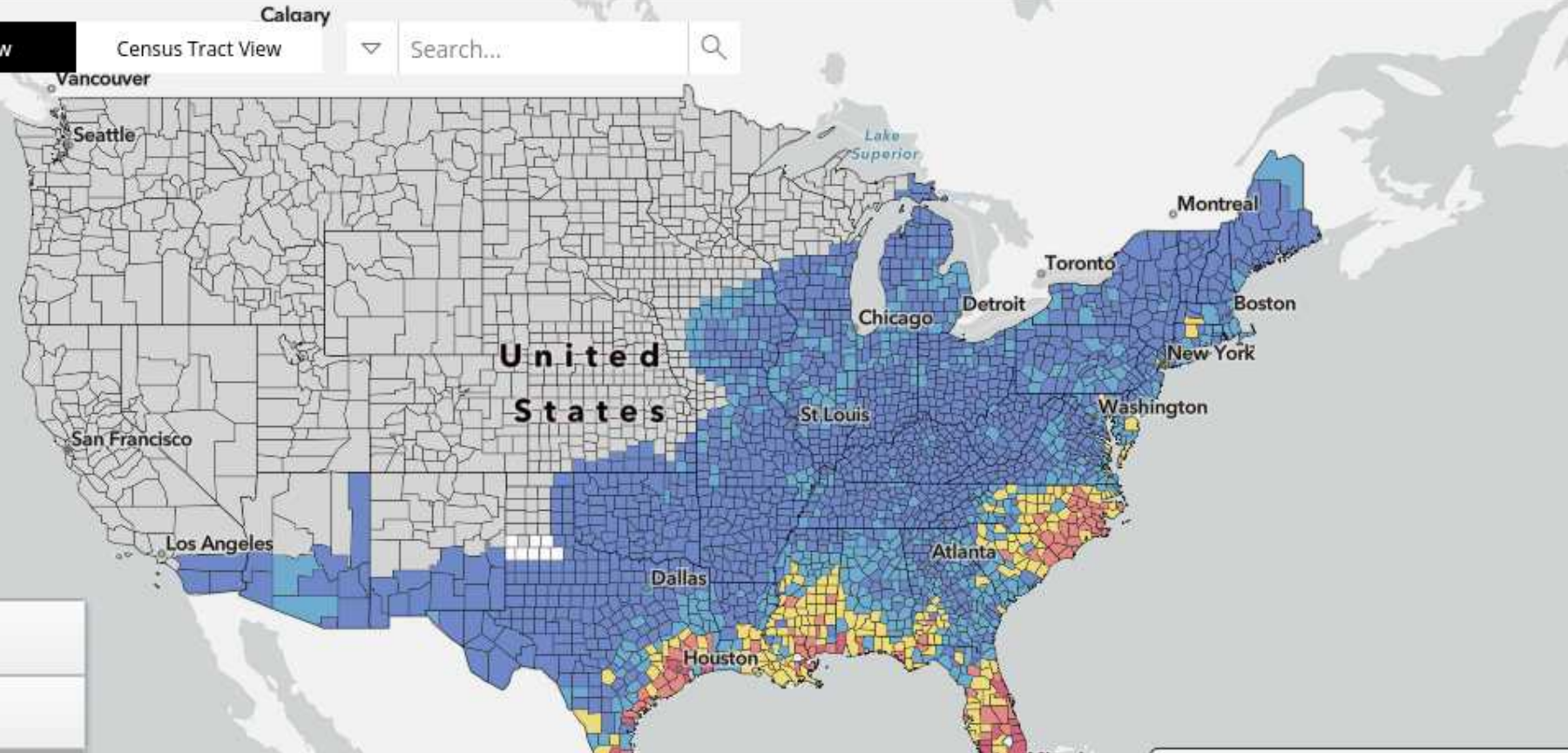
Hurricane (RI)

Expected Annual Loss

Social Vulnerability

Community Resilience

County View **Calgary** Census Tract View Search...



Legend

Basemaps

Strong Wind (High Impact)



FEMA

National Risk Index



Explore the Map

Learn More

Take Action

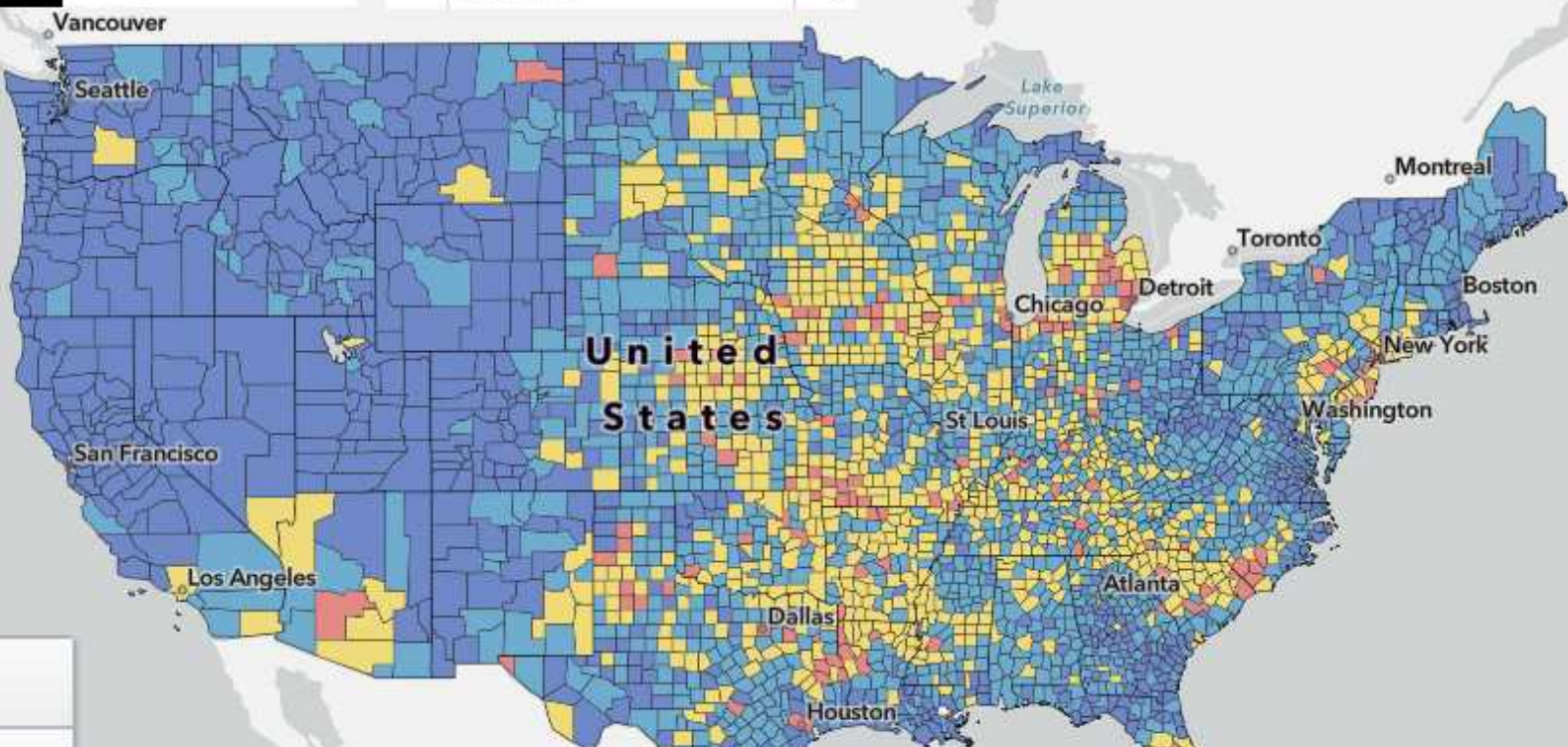
Strong Wind (RI)

Expected Annual Loss

Social Vulnerability

Community Resilience

County View | Census Tract View | Search...



Legend

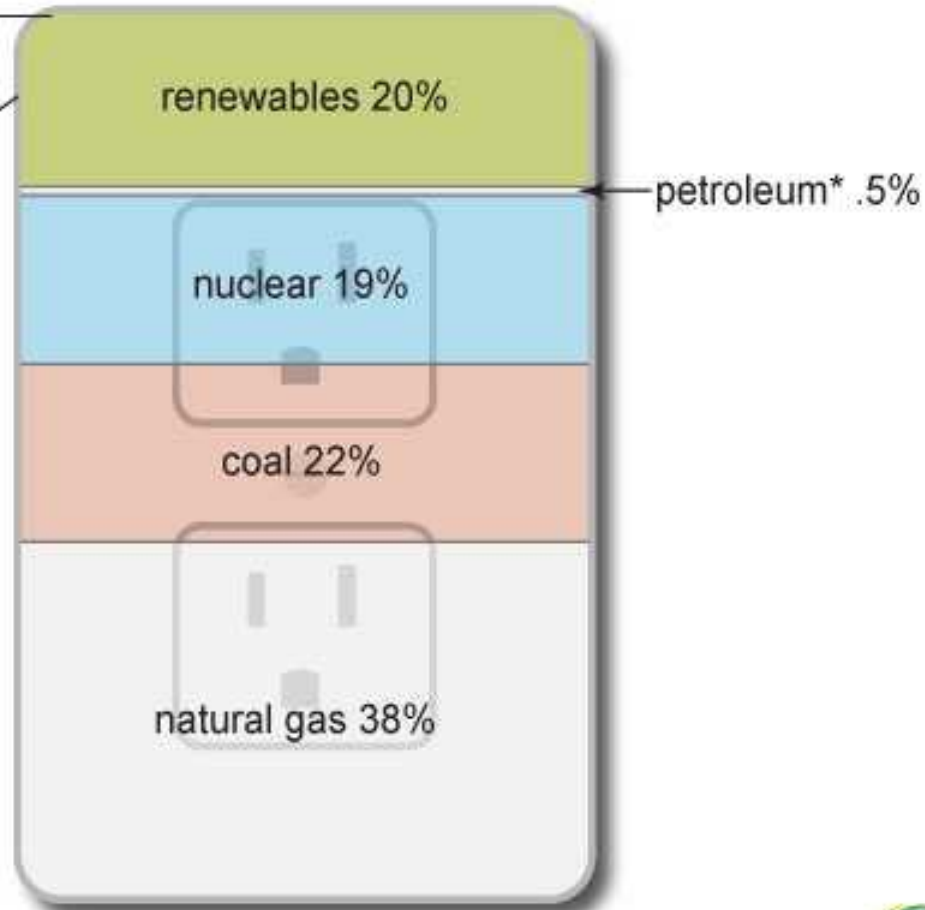
Basemap

Is solar a big enough
energy source to
worry about?

Sources of U.S. electricity generation, 2021

Total = 4.12 trillion kilowatthours

wind	9.2%
hydro*	6.3%
solar	2.8%
biomass	1.3%
geothermal	0.4%



- **Solar**
2.8%

Data source: U.S. Energy Information Administration, *Electric Power Monthly*, February 2022, preliminary data



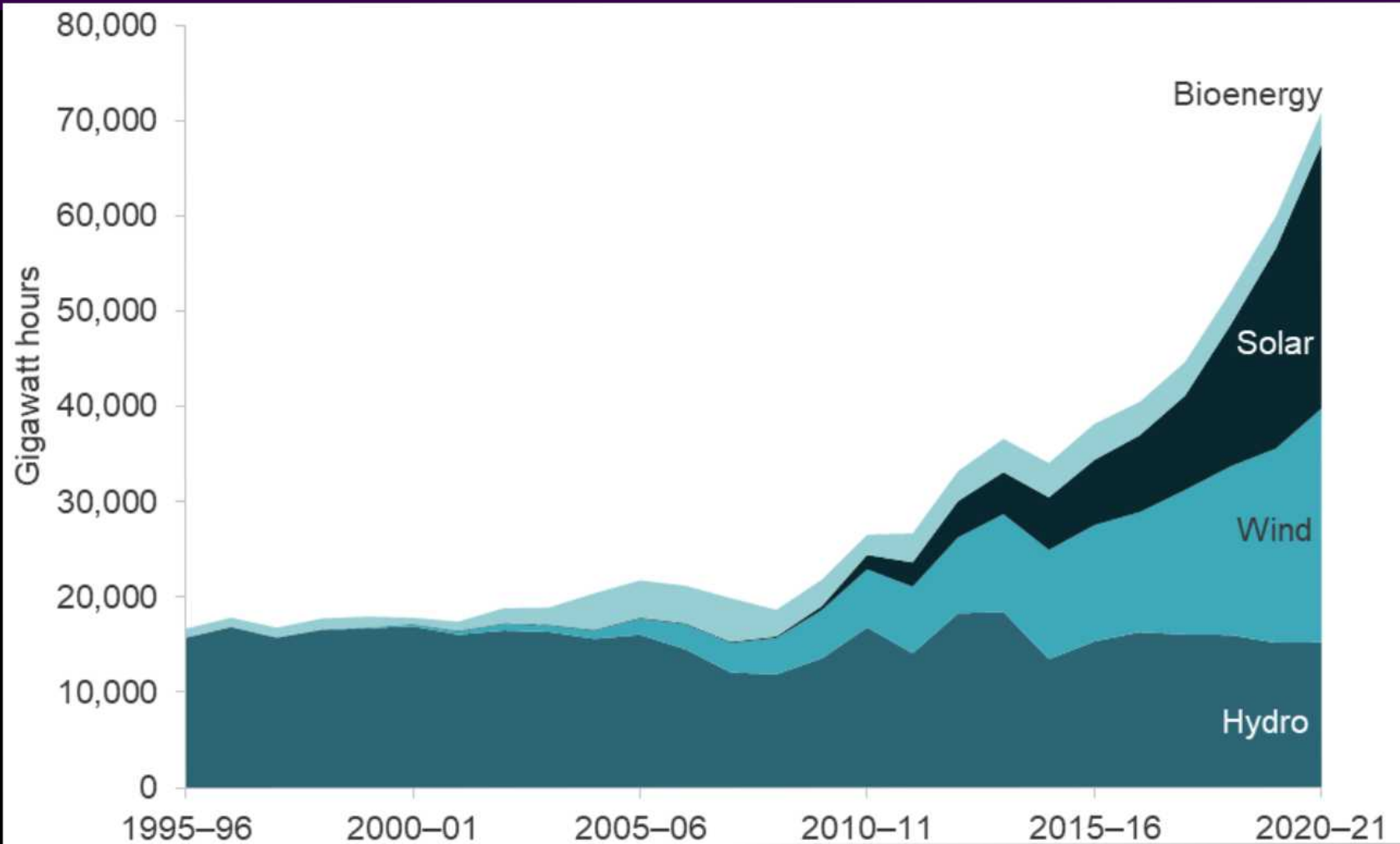
Note: Includes generation from power plants with at least 1,000 kilowatts of electric generation capacity (utility-scale).

*Hydro is conventional hydroelectric. *Petroleum includes petroleum liquids, petroleum coke, other gases, hydroelectric pumped storage, and other sources.

Australia



Solar on the up



- Solar may only be 2.8%
USA and higher is AUS
but...

- Solar may *only* be 2.8% USA and higher is AUS but...
- *Significantly* higher in some places

Hawaii is a good example

In 2022, solar power provided about **17%** of Hawaii's total electricity..

Note:

**I presented these Hawaiian
statistics in April 2023**

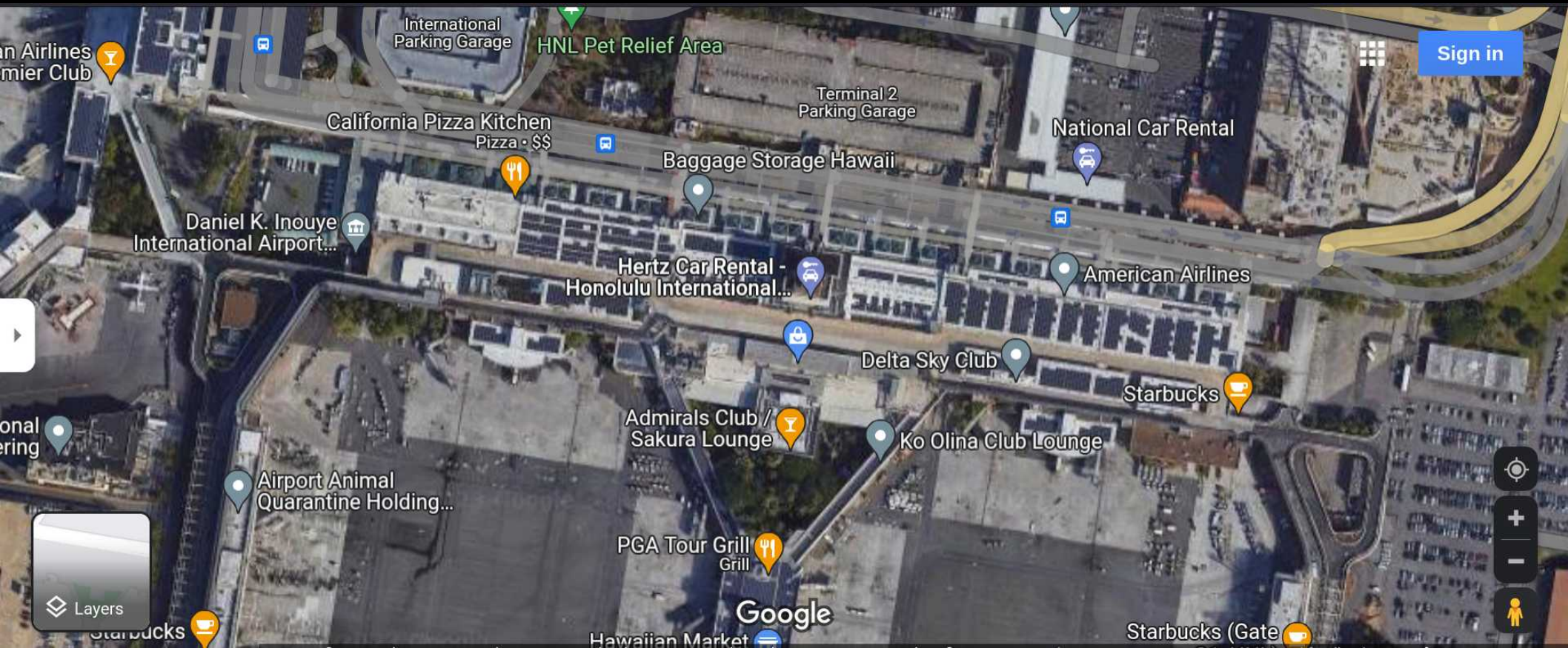
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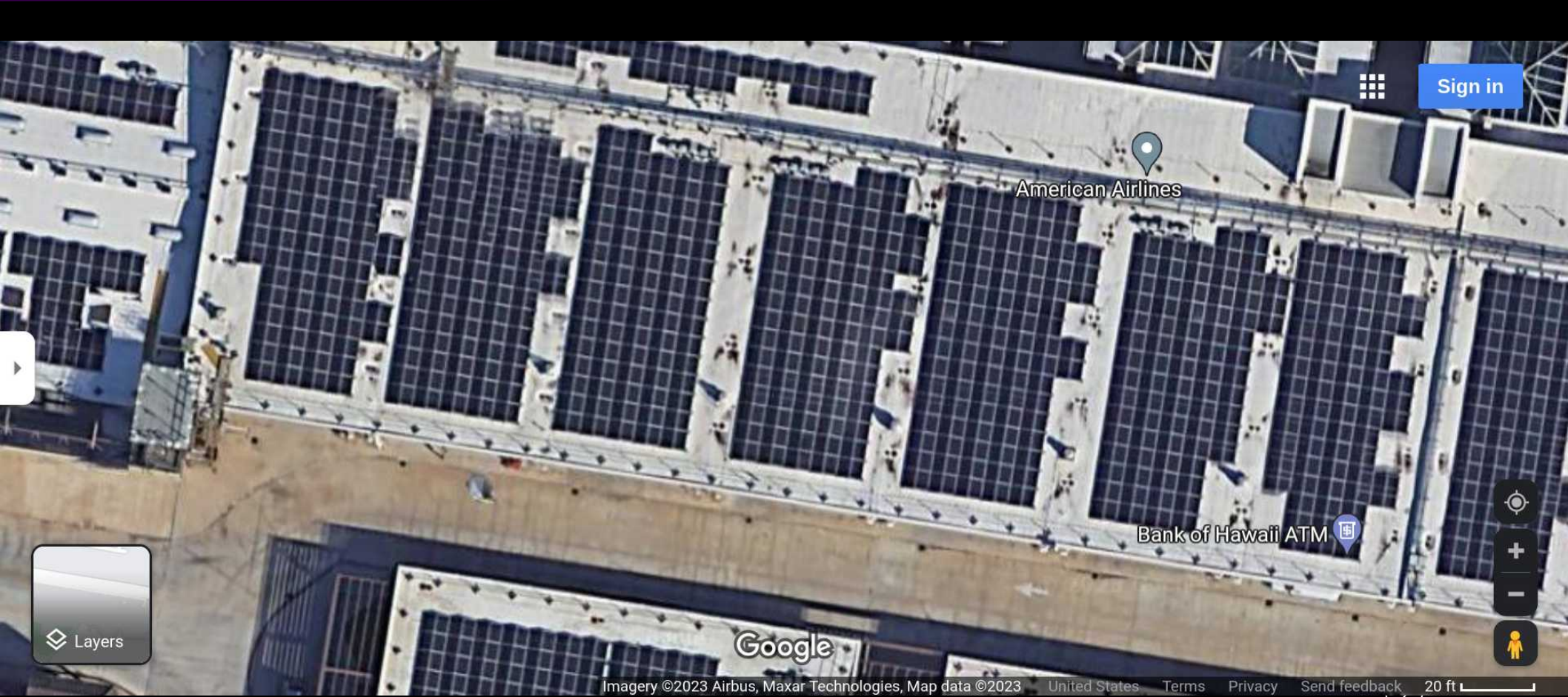
.. small-scale, customer-sited solar power generation

.. 10th-highest among the states.

Hawaii Airport



Solar panels on Hawaii Airport



Sign in

American Airlines

Bank of Hawaii ATM

Google

Layers

Google maps

- Provides a literal 1:1 map of high risk energy solar dependent areas

ID panels

- East West panels



ID panels

- East West panels
- Power all day



ID panels

- East West panels
- Power all day
- Older style arrangement



**Darker panels == higher
efficiency**

Darker panels == higher
efficiency

Higher efficiency == newer
panels

Darker panels == higher
efficiency

Higher efficiency == newer
panels

Newer panels == Wifi and shit

Hawaii airport



Department of Transportation
Airports[Home](#) ▾ [COVID-19 Updates](#) [FAQs](#) [About](#) [Visitor Info](#) [Library](#) [Doing Business](#)[Home](#) » [Main, News](#) » Installation of nearly 3,000 solar panels at HNL complete

INSTALLATION OF NEARLY 3,000 SOLAR PANELS AT HNL COMPLETE

Posted on Apr 3, 2019 in [Main, News](#)

All stalls on the 5th floor of the Terminal 2 garage available for public parking

HONOLULU – The Hawaii Department of Transportation (HDOT) is pleased to announce the completion of the installation of 2,980 additional photovoltaic panels on the 5th floor of the Terminal 2 (formerly the Overseas Terminal) garage at the Daniel K. Inouye International Airport (HNL). Construction on the Terminal 2 panels began on Jan. 7, 2019, as part of HDOT's sustainability and energy savings efforts.

<https://hidot.hawaii.gov/airports/installation-of-nearly-3000-solar-panels-at-hnl-complete/>

Hawaii Department of Transportation (HDOT)

Terminal 2 garage... Contract with
Johnson Controls Inc.

\$600 million in energy savings for
the airports division

largest single state contract of its
kind in the nation.





DANIEL K. NOUYE INTERNATIONAL AIRPORT

84°F







USA

TRD SPORT



Brisbane Airport



Topics



Search



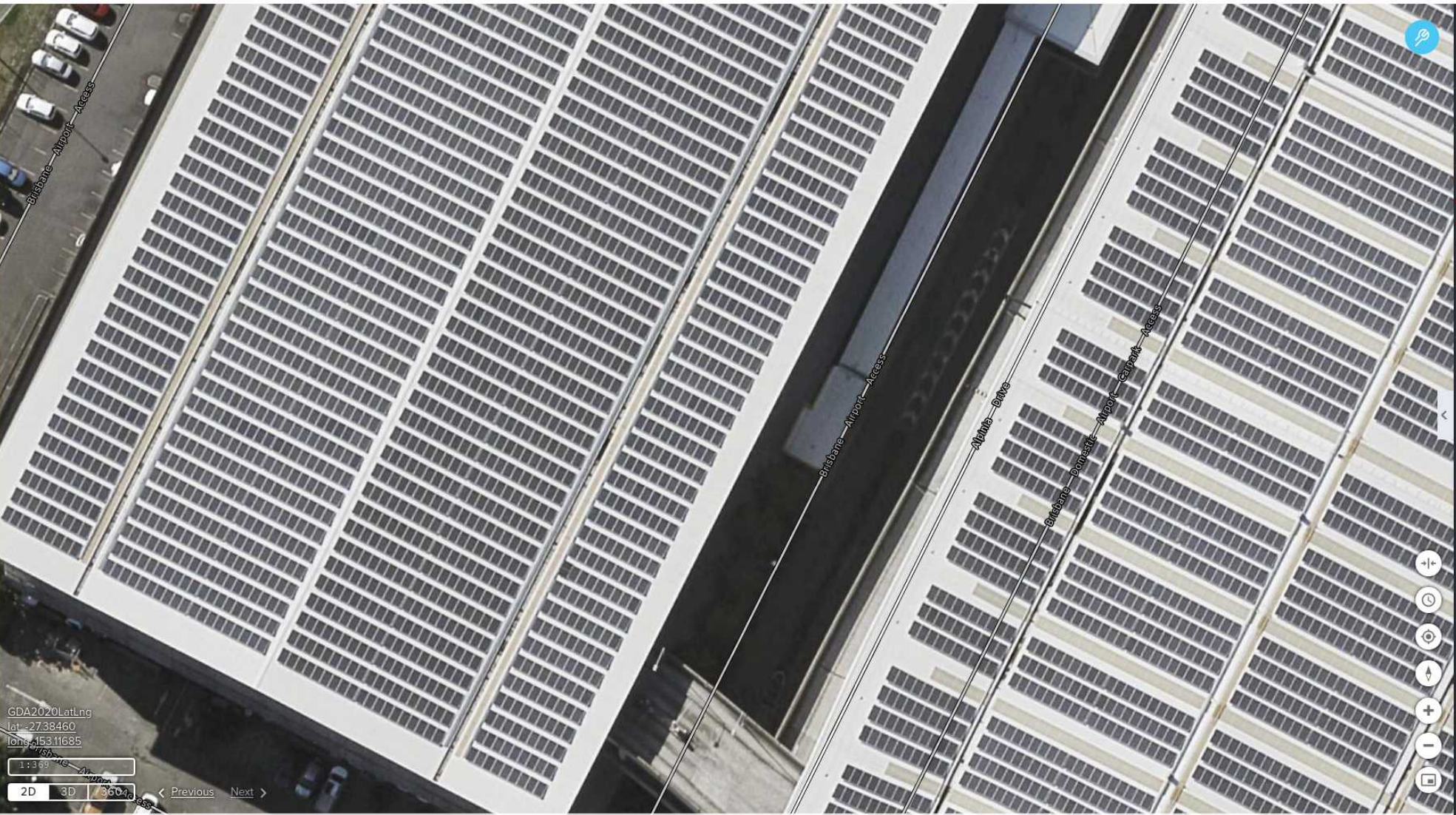
Layers



Places



- Topics
- Search
- Layers
- Places
- Maps
- Print
- Help



- Navigation icons: Home, Back, Forward, Refresh, Full Screen, etc.

B



Brisbane

Airport

Brisbane Airport Access





Corporate > projects > BNE Projects > Completed Projects > Solar Upgrade

Case Study - Solar Upgrade

BNE Projects

Current Projects

Completed Projects

Airport Master Plan

Airspace Protection

🕒 Timing: April to December 2018

📅 Investment: \$11 million

👷 Construction jobs: 40+

<https://www.bne.com.au/corporate/projects/bne-projects/completed-projects/solar-upgrade>

Solar upgrade project at Brisbane Airport



<https://www.youtube.com/watch?v=qFfOmQBQuaU>

Solar upgrade project at Brisbane Airport



**OR 750 HOUSEHOLDS
INSTALLING SOLAR PANELS**

<https://www.youtube.com/watch?v=qFfOmQBQuaU>

Solar upgrade project at Brisbane Airport



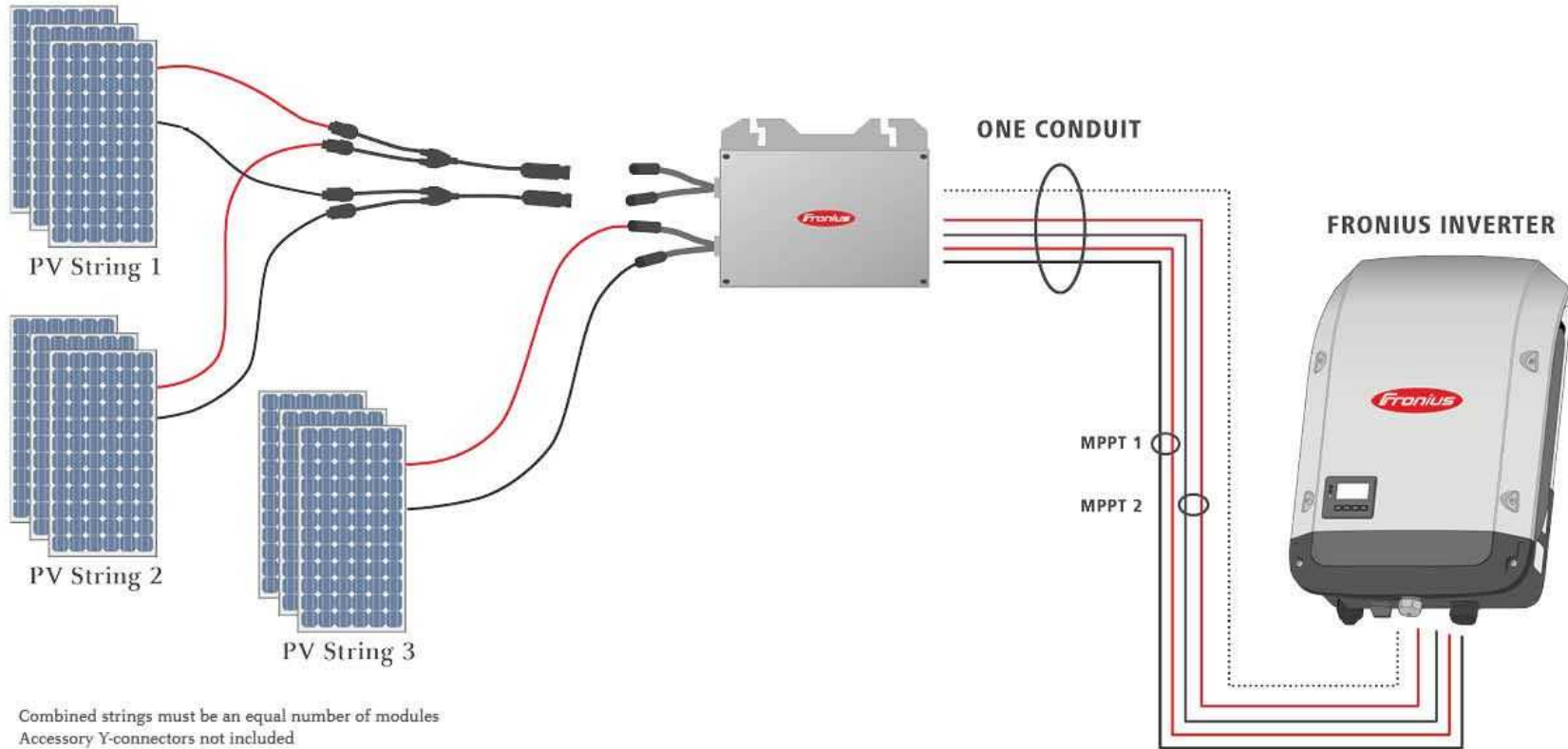
<https://www.youtube.com/watch?v=qFfOmQBQuaU>

What is that box?

- **The Inverter**

What even is a solar system?

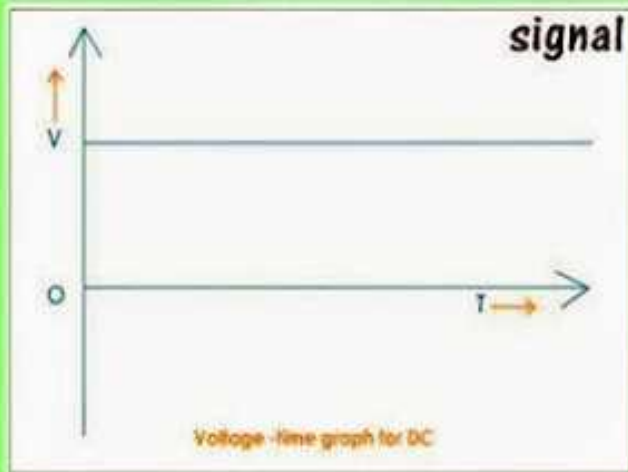
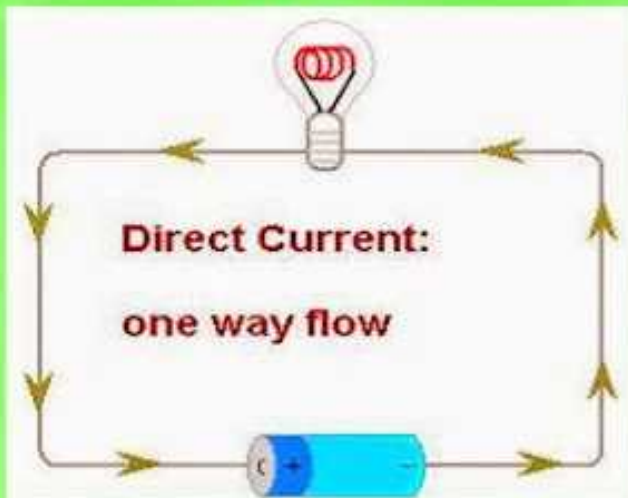
SAMPLE STRING INVERTER CONFIGURATION WITH RAPID SHUTDOWN - NEC 2014



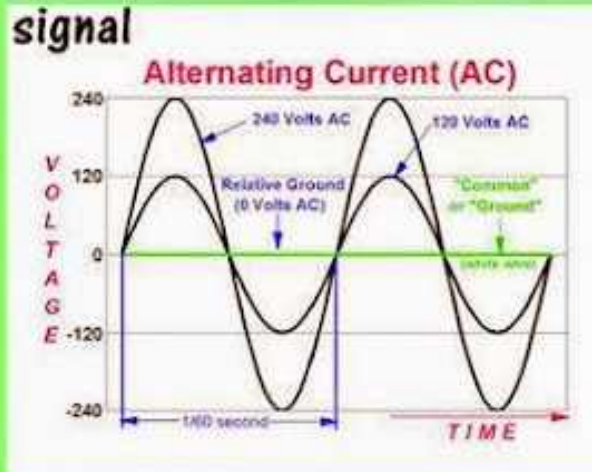
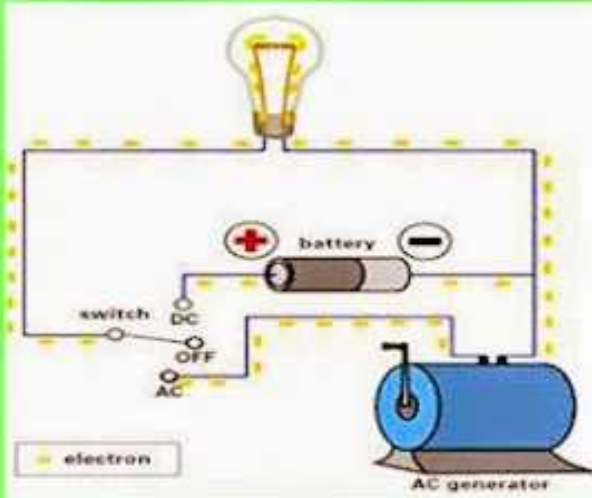
Combined strings must be an equal number of modules
Accessory Y-connectors not included

--- Activation wiring

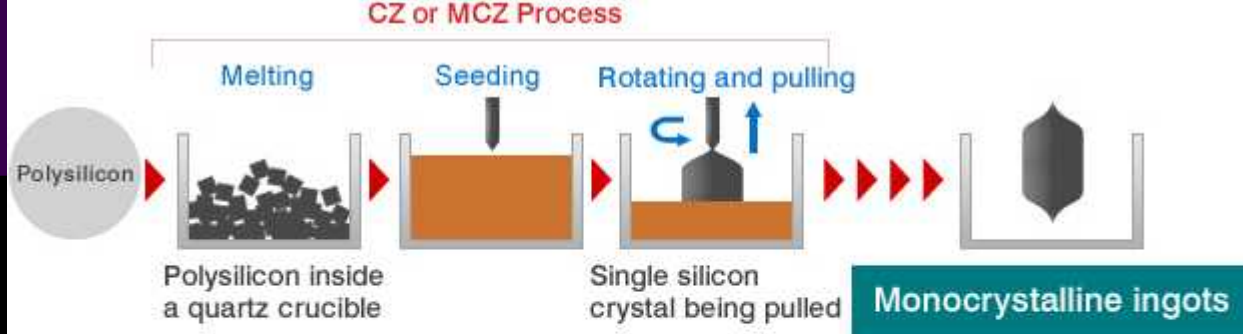
DC



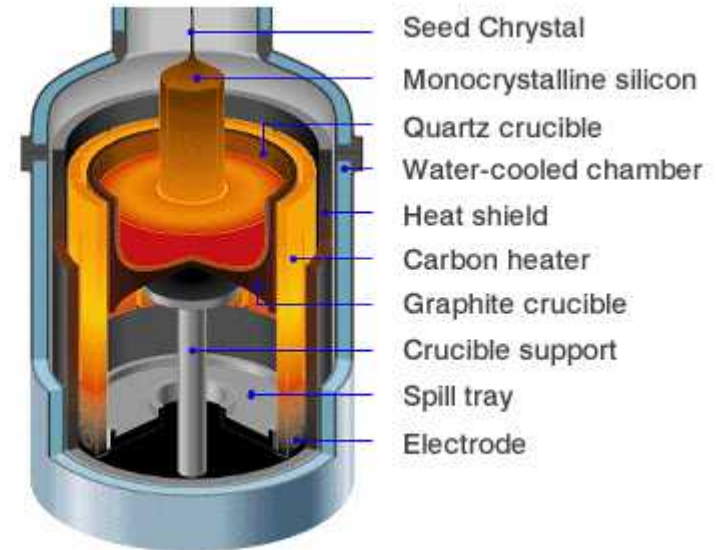
AC



2+ Types



Czocharalski furnace



https://www.sumcosi.com/english/products/process/step_01.html

Old Polycrystalline Method



Better and better



www.cleanenergyreviews.info

Silicon Solar Cell Manufacturing Process



Silica Sand



Crystalline Silicon



Monocrystalline Ingot



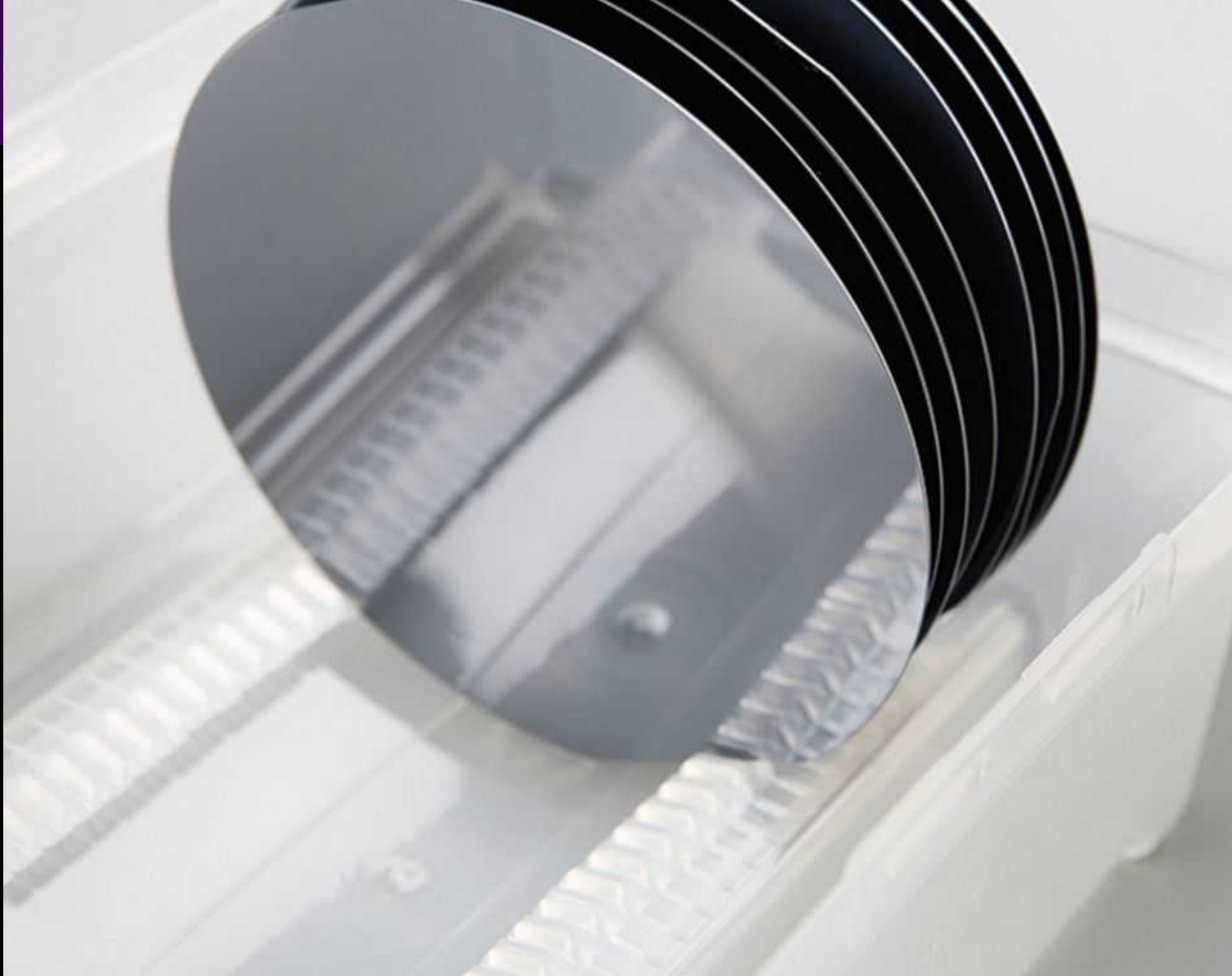
Silicon Wafer



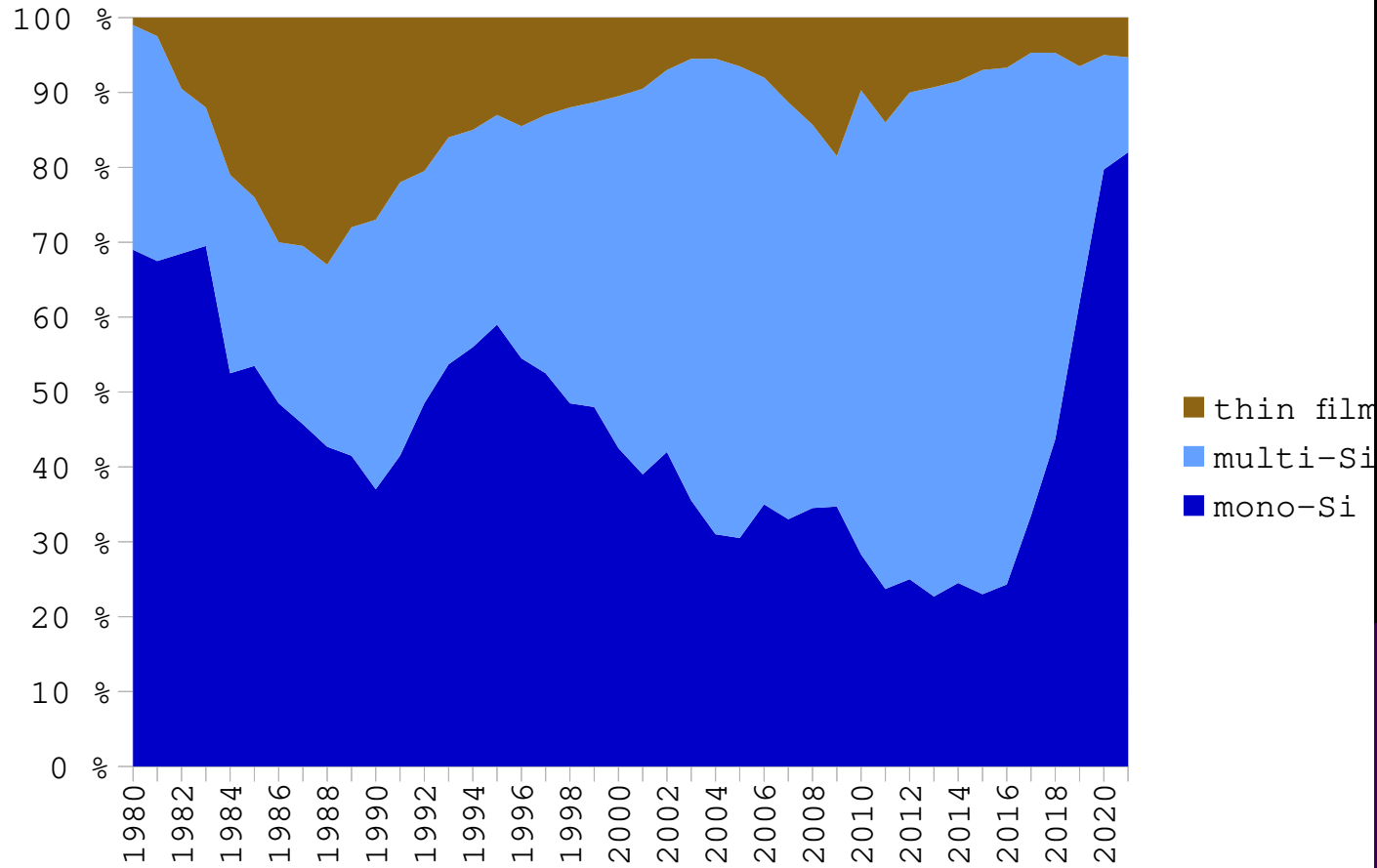
Solar cell

Monocrystalline silicon

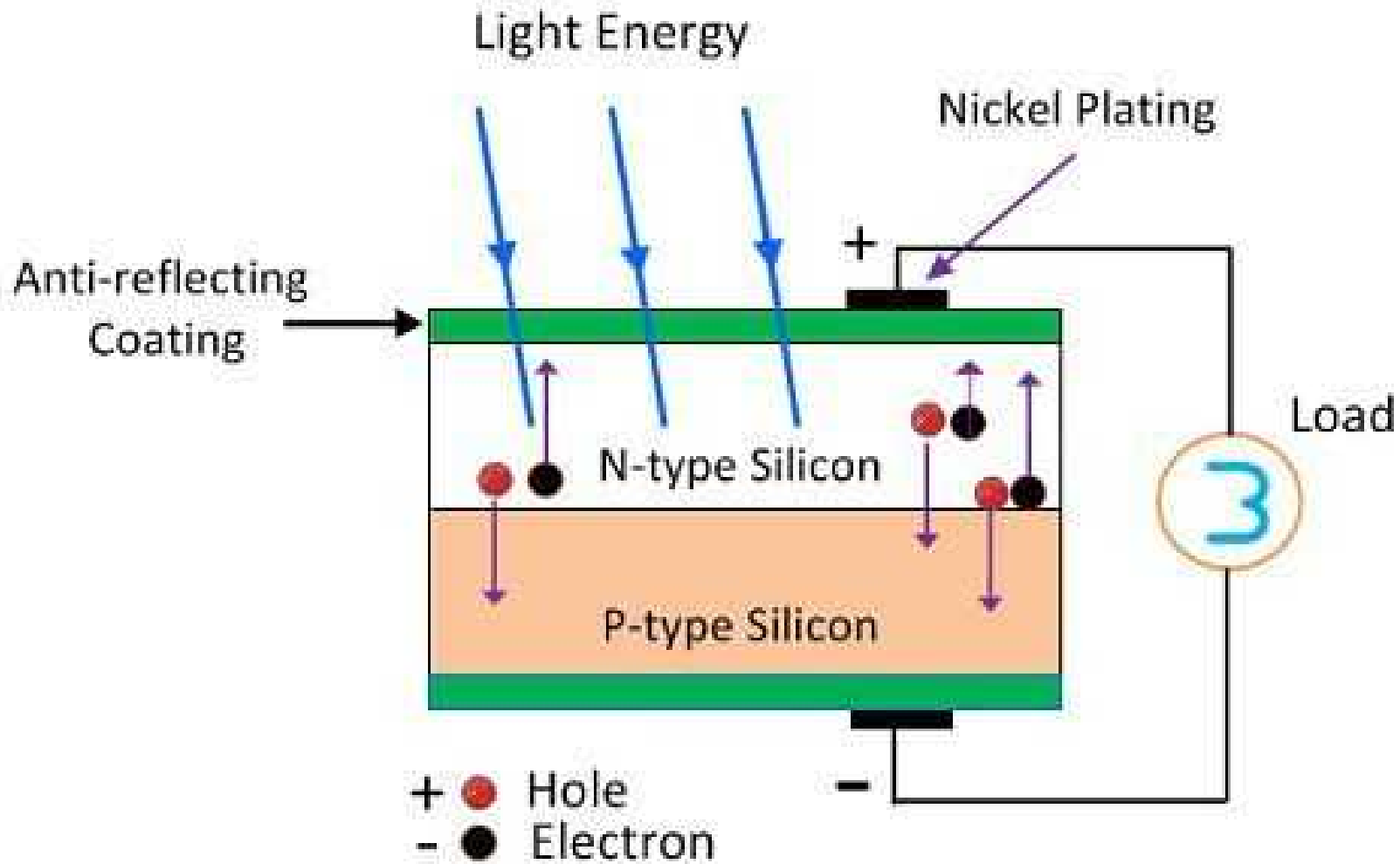




Monocrystalline silicon

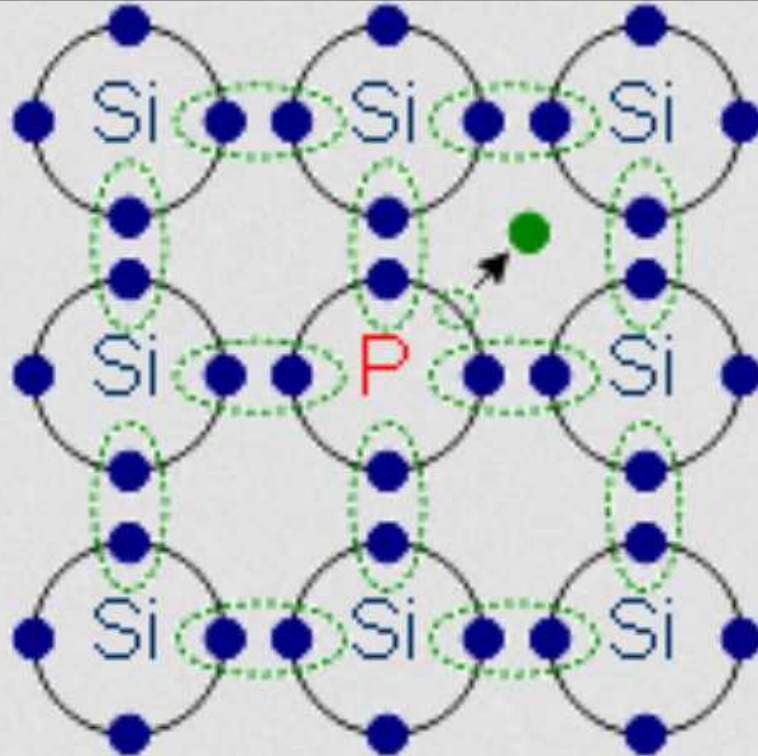


Dope with boron & phosphorous



Solar is simple af

- boron (3 valence electrons = 3-valent)
- phosphorus (5 valence electrons = 5-valent)



The phosphorus atom donates its fifth valence electron. It acts as a free charge carrier.

Remember

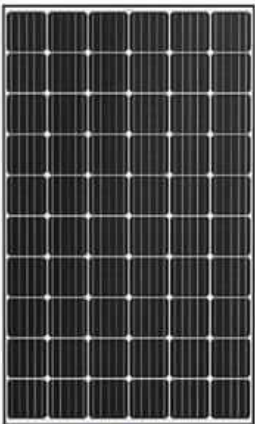
- Darker = Power



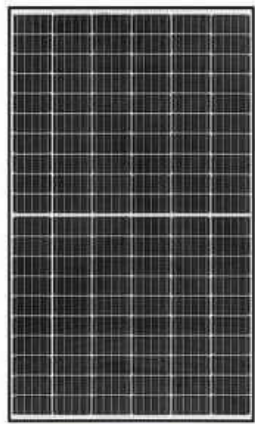
Solar Cell Type and Panel Efficiency



Poly PERC
16 - 17%



Mono PERC
17 - 19%



Half-cut mono PERC
18 - 20%



Shingled mono cells
19 - 21.5%



Half-cut mono PERC MBB
20 - 22%



Half-cut N-Type TOPcon
20 - 22.5%



Half-cut N-Type HJT
21 - 22.5%



N-Type IBC
21 - 23%



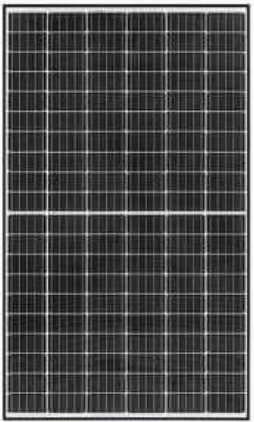
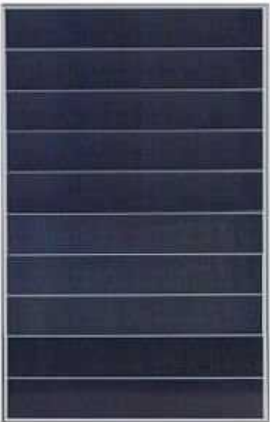
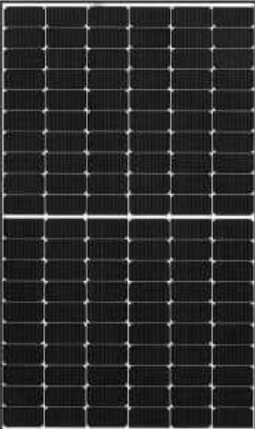



Remember

- Darker = Power

- Help to ID via satellite

CLEAN ENERGY REVIEWS

Solar Cell Type and Panel Efficiency

			
Poly PERC 16 - 17%	Mono PERC 17 - 19%	Half-cut mono PERC 18 - 20%	Shingled mono cells 19 - 21.5%
			
Half-cut mono PERC MBB 20 - 22%	Half-cut N-Type TOPcon 20 - 22.5%	Half-cut N-Type HJT 21 - 22.5%	N-Type IBC 21 - 23%

#	Make	Model	Power	Efficiency
1	SunPower	Maxeon 6	440 W	22.8 %
2	Canadian Solar	CS6R-H-AG	440 W	22.5 %
3	REC	Alpha Pure R	430 W	22.3 %
4	SPIC	Andromeda 2.0	440 W	22.3 %
5	Qcells	Q.Tron-G1+	400 W	22.3 %
6	Panasonic	EverVolt H	410 W	22.2 %
7	Jinko Solar	Tiger NEO	480 W	22.2 %
8	Belinus	M8 IBC Ultra	400 W	22.0 %
9	Longi Solar	Hi-Mo 6	430W	22.0 %
10	Phono Solar	Draco Mono-M6	430 W	22.0 %

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The inverter is
the WiFi boii









Not discussing micro
inverters today, e.g.
Enphase

**The inverter is
the WiFi boii**

Inverters

- Fronius (AT)
- SolarEdge (IL, CN)
- Huawei (CN)
- SMA (DE, CN)
- SUNGROW (CN)
- GOODWE (CN)
- GROWATT (CN)









Best Solar Inverters 2022

No	Picture	Make	Model	Sizes (kW)	Warranty*	Key Features	Price Range AUS
1		Fronius	Primo	3,4,5,6,8,2	10 Year	Snap-in design, Hidden connections, LCD display, Dynamic shade function, Austrian made	\$1300 to \$2450
2		SolarEdge	HD Wave	3,4,5,6,8,10	12 Year	DC Optimisers, panel level monitoring	\$1450 to \$2650^
3		Huawei	SUN2000L1	3,3.6,4,5,6	10 Year	Hybrid inverter, optional DC optimisers	\$1250 to \$1650
4		SMA	Sunny Boy	3,3.6,4,5,6	5+5 Year*	German made, Shadefix setting	\$1200 to \$1850
5		Sungrow	SG Premium	2,2.5,3,5,8	10 Year	LCD Display, very high efficiency	\$950 to \$1500
6		FIMER	UNO DM PLUS	3,3.3,4,6,5	10 Year	High MPPT current for Parallel strings	\$1200 to \$1600
7		Goodwe	DNS Series	3,3.6,4,2,5,6	5 Year*	LCD Display, shadow scan setting	\$750 to \$950
8		DELTA	Home Series	2.5,3,4,5	5 Year*	Very low startup voltage, high efficiency	\$950 to \$1350

Inverters

- Fronius (AT)
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Best Solar Inverters 2022

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What is the important feature?

(according to customers)

<https://www.cleanenergyreviews.info/blog/best-grid-connect-solar-inverters-sma-fronius-solaredge-abb>

What is the important feature?

**WiFi
monitoring**

the wifi in
the living
room



the wifi
in my
bedroom



<https://www.cleanenergyreviews.inverters-sma-fronius-solaredge-a>



Can you cause
catastrophic failure
over WiFi?

Let's take a look

What should we look for?

What should we look for?

- Software controlled limits

What should we look for?

- Software controlled limits
- Bad code

What should we look for?

- Software controlled limits
- Bad code
- Bad installation process (with respect to networking)

What should we look for?

- Software controlled limits
- Bad code
- Bad installation process (with respect to networking)
- Large single points of failure

What should we look for?

- Software controlled limits
- Bad code
- Bad installation process (with respect to networking)
- Large single points of failure
 - *Such as centralized control..*

Briefly:

The logo for NERC, consisting of the letters 'NERC' in a bold, white, sans-serif font, positioned above a thick white horizontal bar.

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

2022 Annual Report

February 2023



Cyber issues according to NERC

2022 STATE OF RELIABILITY

The State of Reliability provides analysis of past bulk power system performance to identify system trends and emerging reliability risk. It also highlights the health of the interconnected bulk power system and the effectiveness of reliability risk mitigation activities.

Leading indicators show that the bulk power system continues to perform in a highly reliable and resilient manner overall with year-over-year improvement, demonstrating the success of industry actions. However, the rapidly changing risk profile requires new approaches to navigate reliability effectively. Significant events in 2021 highlight the need for aggressive action.



Extreme cold weather across South Central United States and Texas led to largest controlled load shedding event in North American history. Unserved energy demand underscores the need for winterization requirements in power generation and addressing resource availability issues.



Severe weather—such as extreme cold and heat, hurricanes, and drought-related wildfires—challenged the bulk power system, underscoring the need for more robust resilience tools to withstand extreme events.



Electricity and natural gas industry interdependencies have evolved from an emerging risk to a realized one, requiring reconsideration of the regulatory framework and coordination between the two sectors.



Multiple solar loss events in Texas and California in 2021 demonstrated that unaddressed inverter issues increase reliability risk, particularly in those large assessment areas that have become dependent upon renewable resources to meet peak loads. New Reliability Standards under development will mitigate inverter risk.



The cyber security threat landscape continues to degrade as demonstrated by geopolitical events, new vulnerabilities, changing technologies, and increasingly bold adversaries. Continued vigilance and effective industry/government information sharing are essential.



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NERC

Inverter issue reliability



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So, can we:

- Force inverters to fail?

So, can we:

- Force inverters to fail?
- Push malware to inverters?

So, can we:

- Force inverters to fail?
- Push malware to inverters?
- Drop a % of inverters at once?

So, can we:

- Force inverters to fail?
- Push malware to inverters?
- Drop a % of inverters at once?
- Force a weather event?



HUAWEI

pv magazine corporate

Smart PV and storage – anytime for anyone

Four Challenges Storage and digitalization help with the biggest hurdles to running a 100% clean power grid

A holistic approach Charting a path to the necessary overhaul of the energy system

Download 

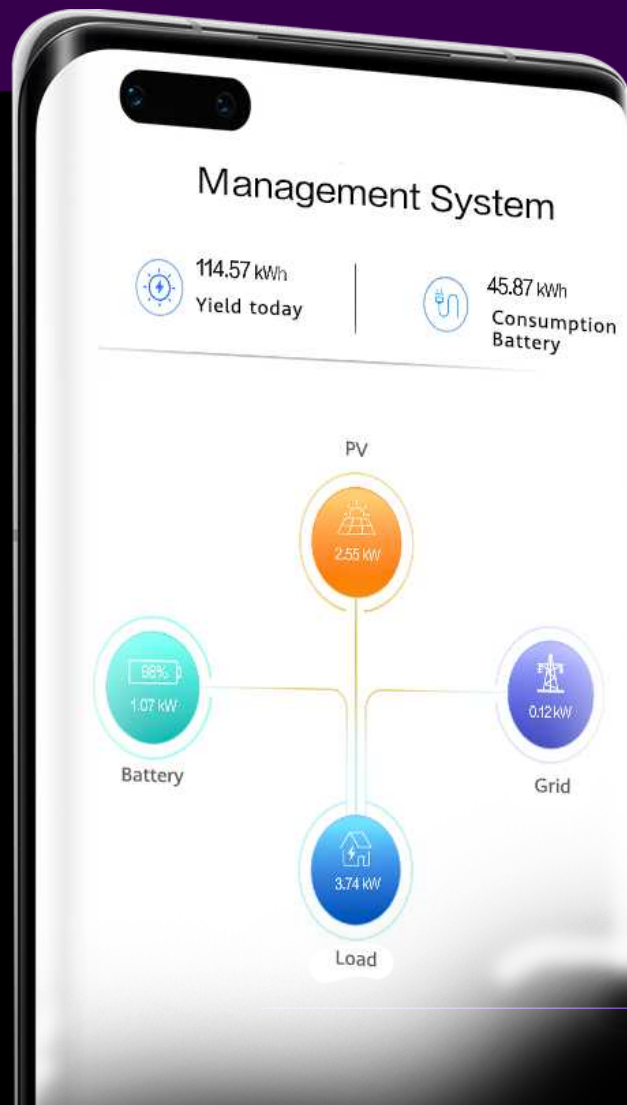
SPECIAL EDITION DEVELOPED IN PARTNERSHIP WITH HUAWEI



SPECIAL EDITION DEVELOPED IN

PARTNERSHIP WITH HUAWEI









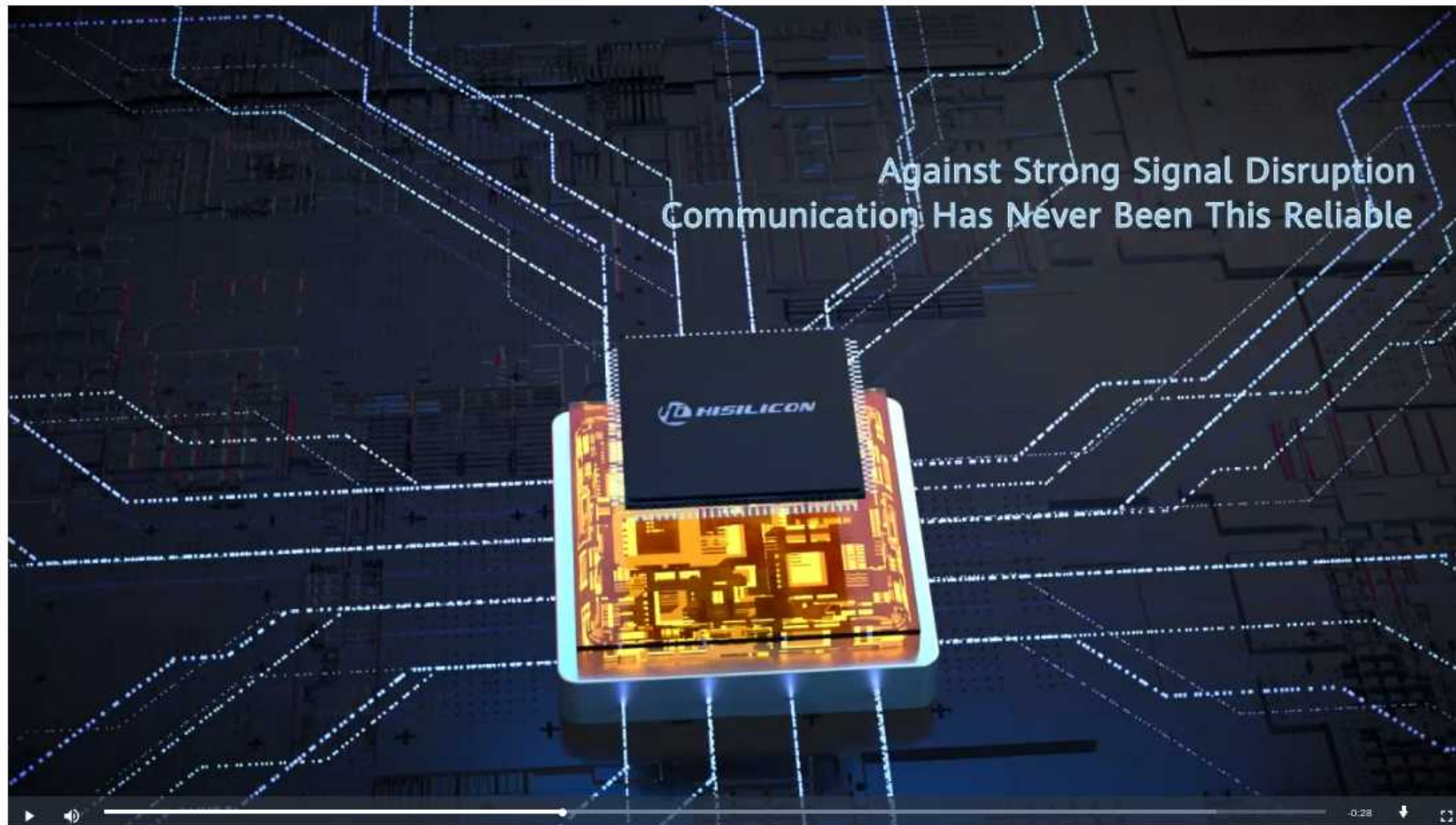
Optimal Electricity Cost



Active Safety



Better Experience





Optim



- **Fabless semiconductors from Shenzhen**

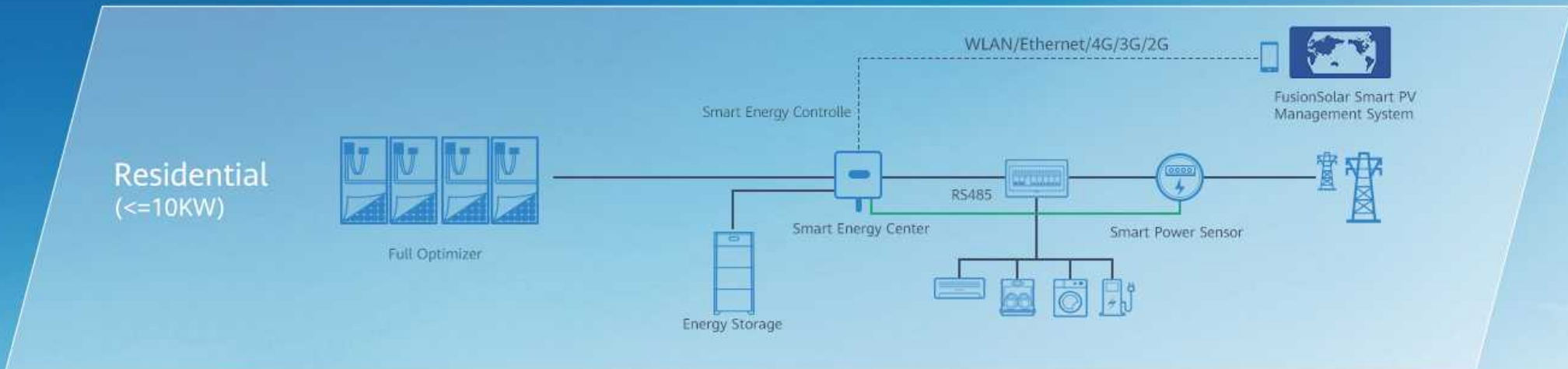
Powered by Hisilicon

- Fabless semiconductors from Shenzhen
- Owned by Huawei

Powered by Hisilicon

- Fabless semiconductors from Shenzhen
- Owned by Huawei
- Immune to certain sanctions

FusionSolar Residential Smart PV Solution



Smart Energy Controller

SUN2000-2/3/3.68/4/4.6/5/6KTL-L1

Single Phase



Smart Energy Controller

SUN2000-3/4/5/6/8/10KTL-M1

Three Phase



Smart String ESS

LUNA2000-5/10/15-S0



Smart PV Optimizer

SUN2000-450W-P



Smart Dongle

Smart Dongle-WLAN-FE
Smart Dongle-4G



Smart Power Sensor

DDSU666-H (Single Phase)
DTSU666-H 100A (Three Phase)
DTSU666-H 250A (Three Phase)



Monitoring Portal

FusionSolar Cloud & APP



Backup Box

Backup Box-B0/B1



Smart String ESS

LUNA2000-5/10/15-S0



Smart PV Optimizer

SUN2000-450W-P



Monitoring Portal

FusionSolar Cloud & APP



Backup Box

Backup Box-B0/B1



Smart Energy Controller

SUN2000-2/3/3.68/4/4.6/5/6KTL-L1

Single Phase



Smart Energy Controller

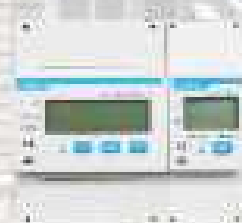
SUN2000-3/4/5/6/8/10KTL-M1

Three Phase



Smart Dongle

Smart Dongle-WLAN-FE
Smart Dongle-4G



Smart Power Sensor

DDSU666-H (Single Phase)
DTSU666-H 100A (Three Phase)
DTSU666-H 250A (Three Phase)

Smart Dongle



Smart Dongle

Smart Dongle-WLAN-FE

Smart Dongle-4G





WLAN-FE-10
SN:HV22A00
37605
REGKEY:bFAR2L

FRONT



WLAN-FE-10



SN:HV22A00

37605

REGKEY:bFAR2L

QR Contents

Text

SN:HV22A0037605 REGKEY:bFAR2L

SSID:SDongleA-HV22A0037605

PSW:Changeme



Smart

WLAN & Fast Ethernet (FE) / 4G communication
Supports 3rd-party monitoring system



Simple

Plug & Play, supports max. 10 devices



Reliable

IP65, supports auto reconnection

IP65

- and rated as "*dust tight*" and protected against *water projected* from a nozzle

IP65

- "Dust tight"
- Protected against water projected from a nozzle



Where does the dongle go?





- Is there anything odd in this pic?



- Outdoor ethernet



Applicable defences...

- DHCP?
- Isolate?
- VPN?
- DMZ?

- SIM
version



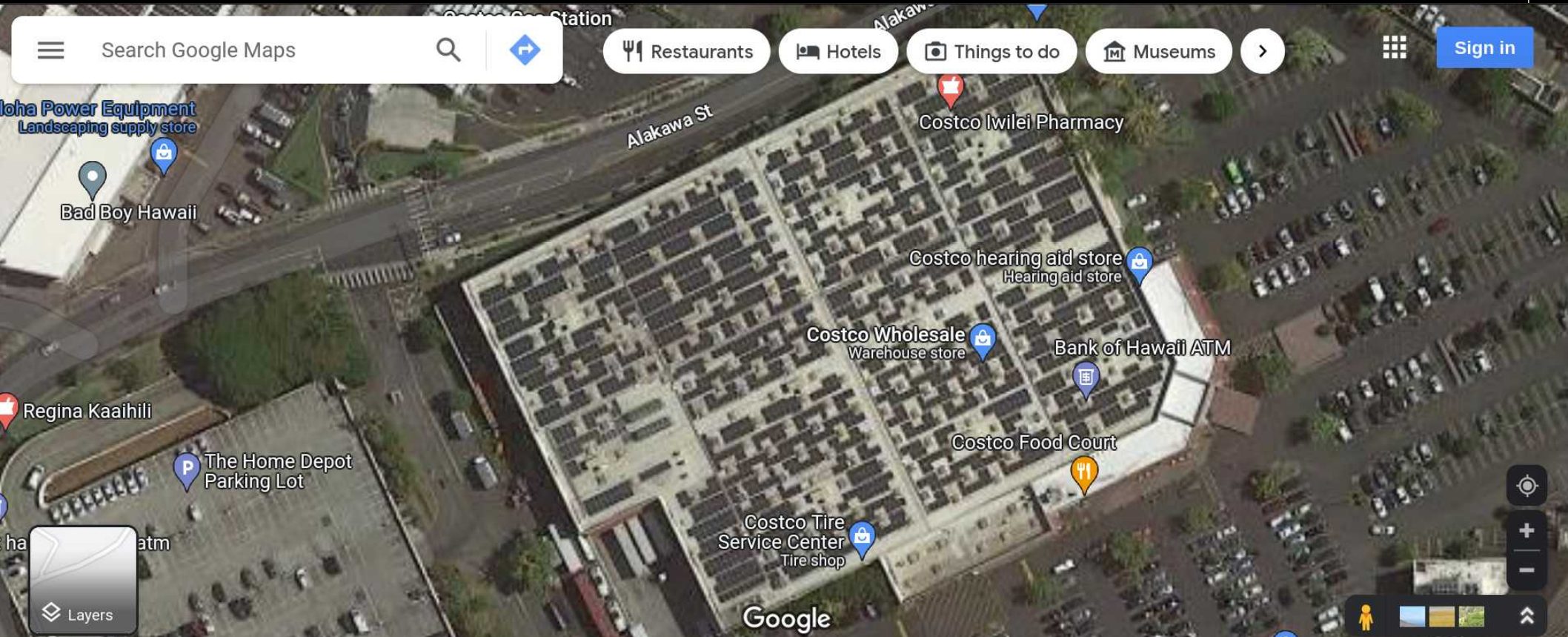
<https://www.pveurope.eu/solar-modules/intersolar-award-2019-huawei-raycatch-and-jinko>

Trying not to dox anyone

Trying not to dox anyone

- All following slides occurred in Minecraft

Costco in Minecraft



Multi storey buildings

- Obviously rooftop systems

Multi storey buildings

- Obviously rooftop systems
- Power suffer from cable resistance

Multi storey buildings

- Obviously rooftop systems
- DC Power level susceptible to cable *length*
- Inverters **typically on the roof**

However

- To avoid fires
- And allow rapid shutdown

However

- To avoid fires
- And allow rapid shutdown
- They're generally accessible



Restaurants



Hotels



Things to do



Museums



99

374

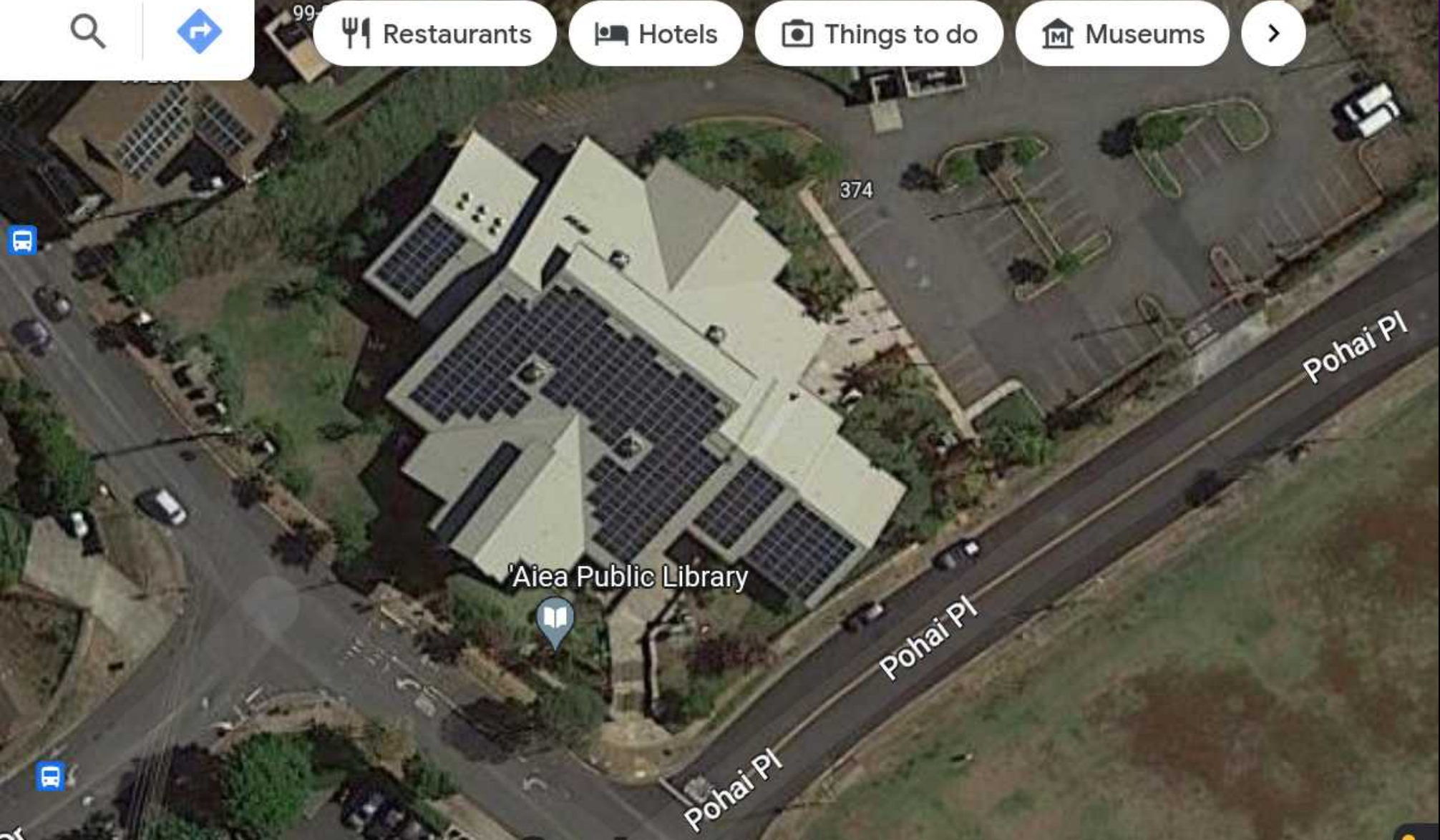
'Aiea Public Library



Pohai Pl

Pohai Pl

Pohai Pl





Restaurants



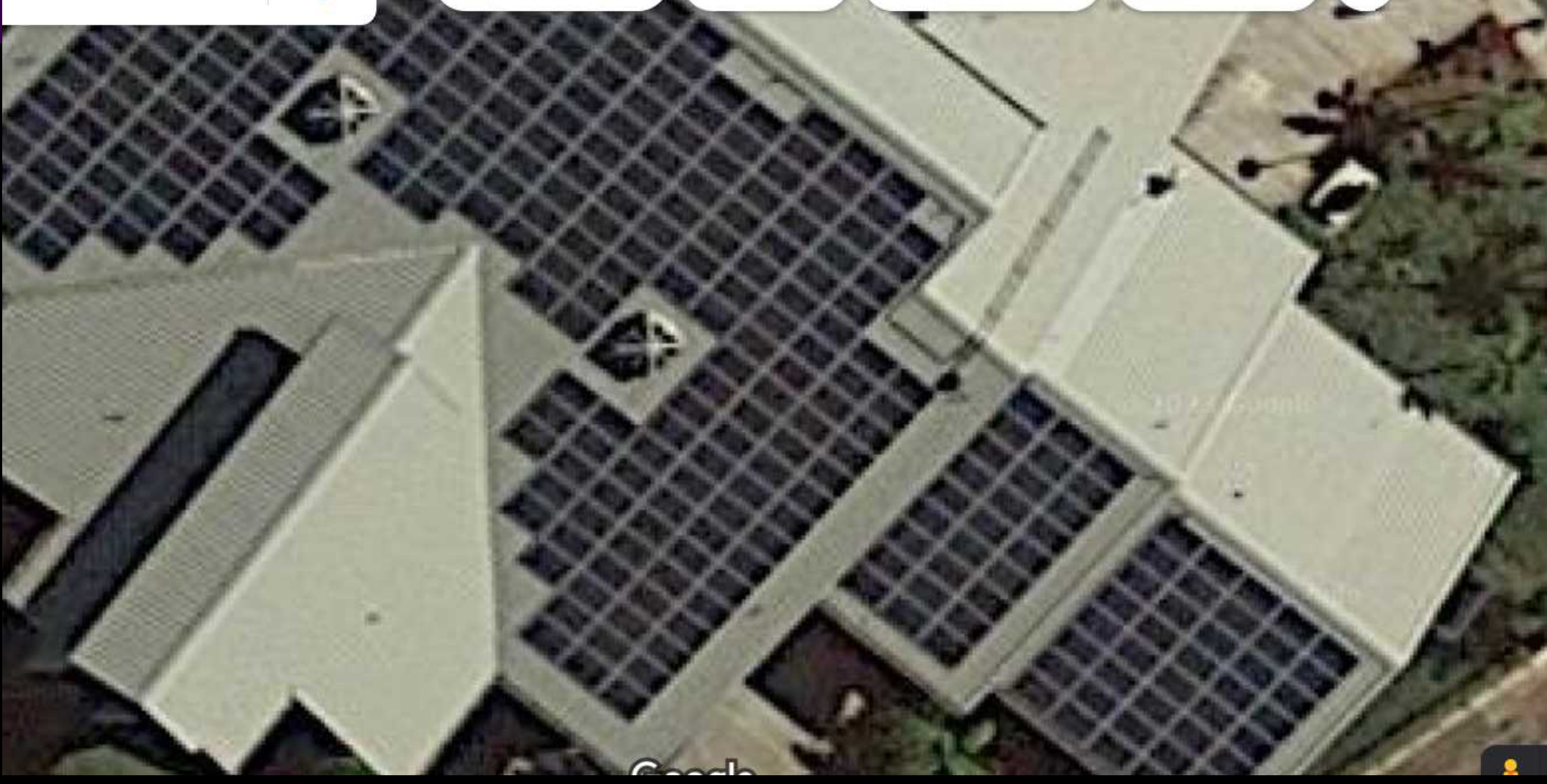
Hotels



Things to do



Museums







dates



Google

Thx G



Useful to access network?

- There's 5G towers up there anyway

Useful to access network?

- There's 5G towers up there anyway
- The Library has free WiFi

Useful to access network?

- There's 5G towers up there anyway
- The Library has free WiFi
- Library isn't important to me

Useful to access network?

- There's 5G towers up there anyway
- The Library has free WiFi
- Library isn't important to me

- Just reminder to read between lines



San Diego



Restaurants

Hotels

Things to do

Museums



San Diego International Airport (SAN) North Harbor Drive



San Diego CA



San Diego Zoo Zoo Drive, San Diego, CA



San Diego International Airport Rental Car Center



San Diego Air & Space Museum See locations

This area

59°



Light traffic in this area

Much faster than usual



Layers



Economy Parking Lot

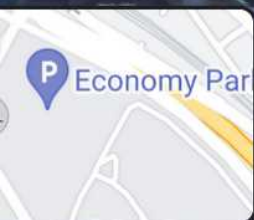
Google

Washington St

o, California

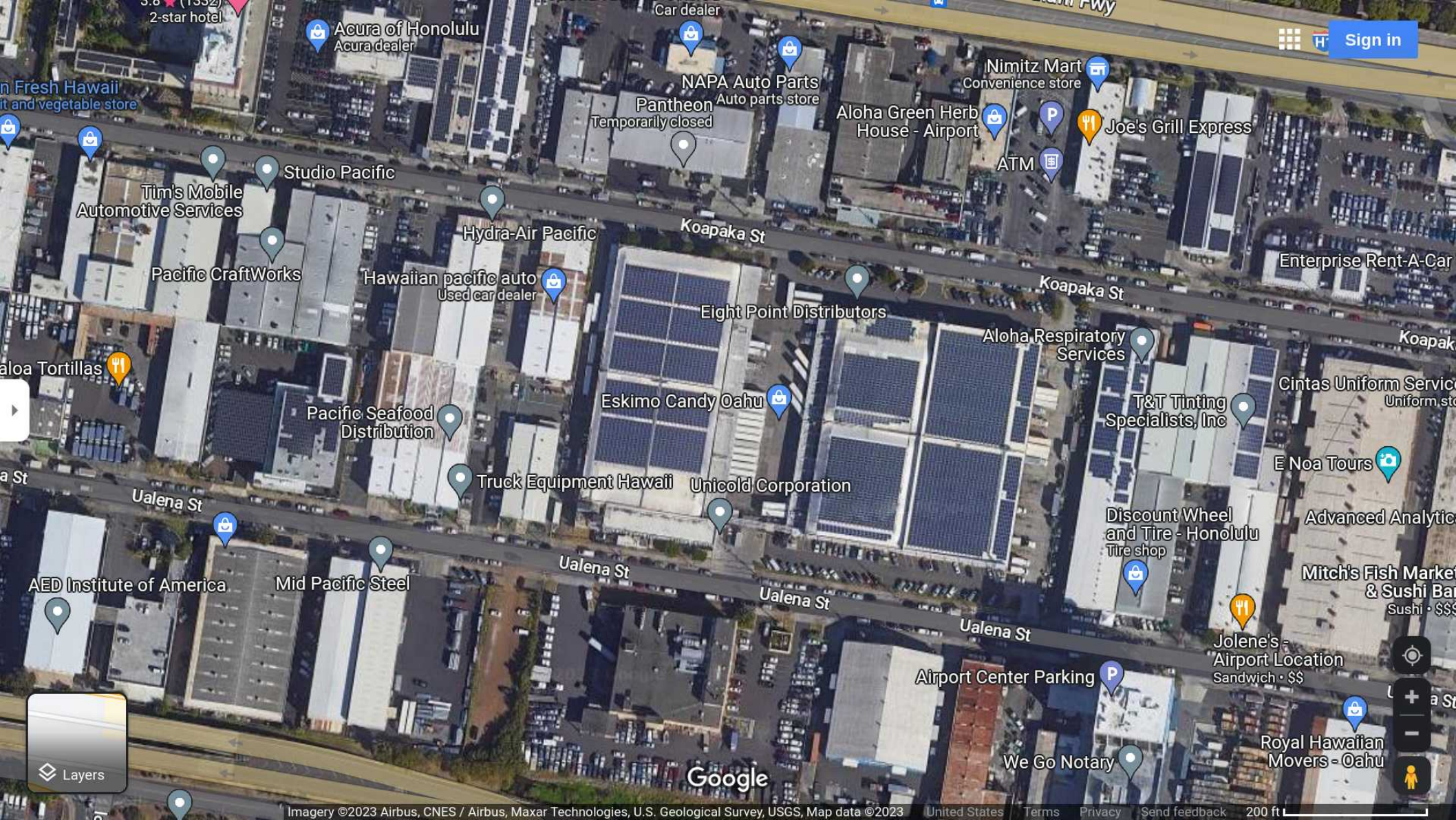
ogle Street View

See more dates



Google





Sign in

Acura of Honolulu
Acura dealer

NAPA Auto Parts
Auto parts store

Nimitz Mart
Convenience store

Joe's Grill Express

Pantheon
Temporarily closed

Aloha Green Herb
House - Airport

ATM

Studio Pacific

Tim's Mobile
Automotive Services

Hydra-Air Pacific

Koapaka St

Pacific CraftWorks

Hawaiian Pacific Auto
Used car dealer

Eight Point Distributors

Koapaka St

Enterprise Rent-A-Car

Aloha Tortillas

Pacific Seafood
Distribution

Eskimo Candy Oahu

Aloha Respiratory
Services

T&T Tinting
Specialists, Inc

Cintas Uniform Service
Uniform store

Ualena St

Ualena St

Pacific Seafood
Distribution

Eskimo Candy Oahu

Unicold Corporation

Discount Wheel
and Tire - Honolulu
Tire shop

E Noa Tours

Advanced Analytic

AED Institute of America

Mid Pacific Steel

Ualena St

Ualena St

Ualena St

Jolene's -
Airport Location
Sandwich - \$\$

Mitch's Fish Market
& Sushi Bar
Sushi - \$\$\$

Airport Center Parking

We Go Notary

Royal Hawaiian
Movers - Oahu

Google

Layers



Google



Google

Image capture: Apr 2019 © 2023 Google United States Terms Privacy Report a problem







JW

MINECRAFT GALACTICRAFT



**SOLAR
POWER**





**CYBERSECURITY
& INFRASTRUCTURE
SECURITY AGENCY**



Alerts and Tips

Resources

[National Cyber Awareness System](#) > [Tips](#) > [Securing Network Infrastructure](#)

Security Tip (ST18-001)

Securing Network Infrastructure Devices

Original release date: June 21, 2018 | Last revised: June 30, 2020



**IP 65
WLAN**

“Primary Entrance”

- **Start with your wireless network.** Secure your Wi-Fi network. Your home’s wireless router is the **primary entrance** for cybercriminals to access all your connected devices. Secure Wi-Fi and digital devices by changing the default password and username. Check your internet provider’s or router manufacturer’s wireless security options. **Your internet service provider and router manufacturer may**



IP65 outdoor usage

- When have you ever **installed** a router *outside* your **house**?

CCTV?

DVR Systems



NVR Systems



[https://
blog.swann.co
m/dvr-vs-nvr-
whats-the-
difference/](https://blog.swann.com/dvr-vs-nvr-whats-the-difference/)

Solutions for Solar?

- Assign an IP for physical port

Solutions for Solar?

- Assign an IP for physical port
- Isolate based on MAC

Solutions for Solar?

- Assign an IP for physical port
- Isolate based on MAC
- VPN? VLAN?

Solutions for Solar?

- Assign an IP for physical port
- Isolate based on MAC
- VPN? VLAN?
- Too much work?

How about centralized control?



The App

Android

FusionSolar App and AppGallery are secure and **can be trusted**. If a system warning message appears during installation, please touch OK to proceed.



Huawei
AppGallery

Android 8.0+



Recommended

[https://intl.fusionsolar.huawei.com/
pvmswebsite/nologin/assets/build/index.html#/
jumpage](https://intl.fusionsolar.huawei.com/pvmswebsite/nologin/assets/build/index.html#/jumpage)

Why can't I find the FusionSolar app in the Google Playstore?

The FusionSolar app is not available on the Google Play Store. You can install the FusionSolar app from the Huawei App Gallery on Huawei devices.

This is how you can install the app:

<https://ske-solar.com/en/fusionsolar-app-im-google-playstore/>

Cool requests

```
Pretty  Raw  Hex  [Menu]  [In]
1 GET /rest/pvms/web/viewsetting/v1/viewcfg?userName=admin&userId=1&viewType=3&_ =1676612550356
  HTTP/1.1
2 Host: intl.fusionsolar.huawei.com
3 Cookie: locale=en-us; utag_main=
```

- GET
/rest/pvms/web/viewsetting/v1/viewc
fg?
userName=admin&userId=1&viewType=3&
_ =1676612550356 HTTP/1.1
- Host: intl.fusionsolar.huawei.com

userId: 1

```
25
26 {
  "data":{
    "listViewContent":"currentPower,dailyEnergy,dailyIncome,dailyCh
    "createTime":1675868482700,
    "viewType":3,
    "userName":"admin",
    "userId":"1"
  },
  "failCode":0,
  "params":[
  ],
  "success":true
}
```

Response

Pretty Raw Hex Render

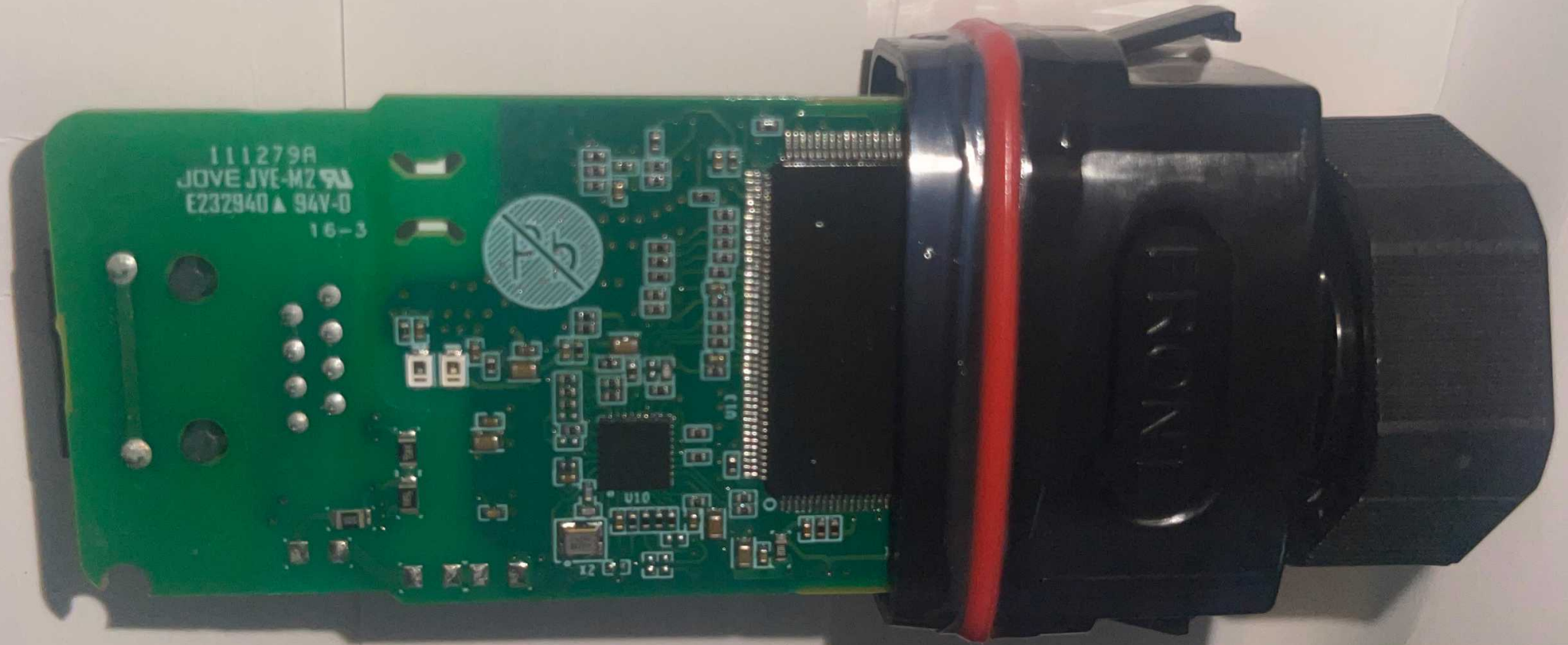
```
25 {
  "csrfToken": "fb6f4142006825e8513d3bd6cb4677ef07a16b81f920e14d",
  "locale": null,
  "user": {
    "id": "128443",
    "name": "sickcodes",
    "domain": null,
    "ops": [
      "pvms.realtime.status.query",
      "pvms.upgrade.defectupgrade.confirm",
      "pvms.task.inspection.task.list.user.setting",
      "pvms.homePage.kpi.socialContribution",
      "pvms.nelog.view",
      "pvms.user.create",
      "pvms.task.defect.user.setting",
      "pvms.systemnote.sending.query",
      "pvms.devlicense.licenseLoad",
      "pvms.default.price.ongrid.query",
      "pvms.station.singleStation.layout.createLayout",
      "pvms.systemnote.sending.create",
      "pvms.device.inspection.stop",
      "pvms.alarm.management.menu",
      "pvms.dashboard.stationLevel.monthlyYield",
      "homemgr.charge.mainten.realtime.view",
      "pvms.upgrade.defectupgrade.appnote.confirm",
      "pvms.homePage.kpi.realtimeAlarm",
      "pvms.homePage.kpi.energyAndIncome",
      "pvms.dashboard.stationLevel.monthlyIncome",
      "pvms.device.detail.realtimeInfo",
      "pvms.device.export.pmData",
      "op.neteco.configuration.visible",
      "pvms.homePage.kpi.stationKpi",
      "pvms.dashboard.companyLevel.omStatistics",
      "pvms.company.menu",
      "pvms.systemnote.sending.menu",
      "pvms.homePage.kpi.menu",
```

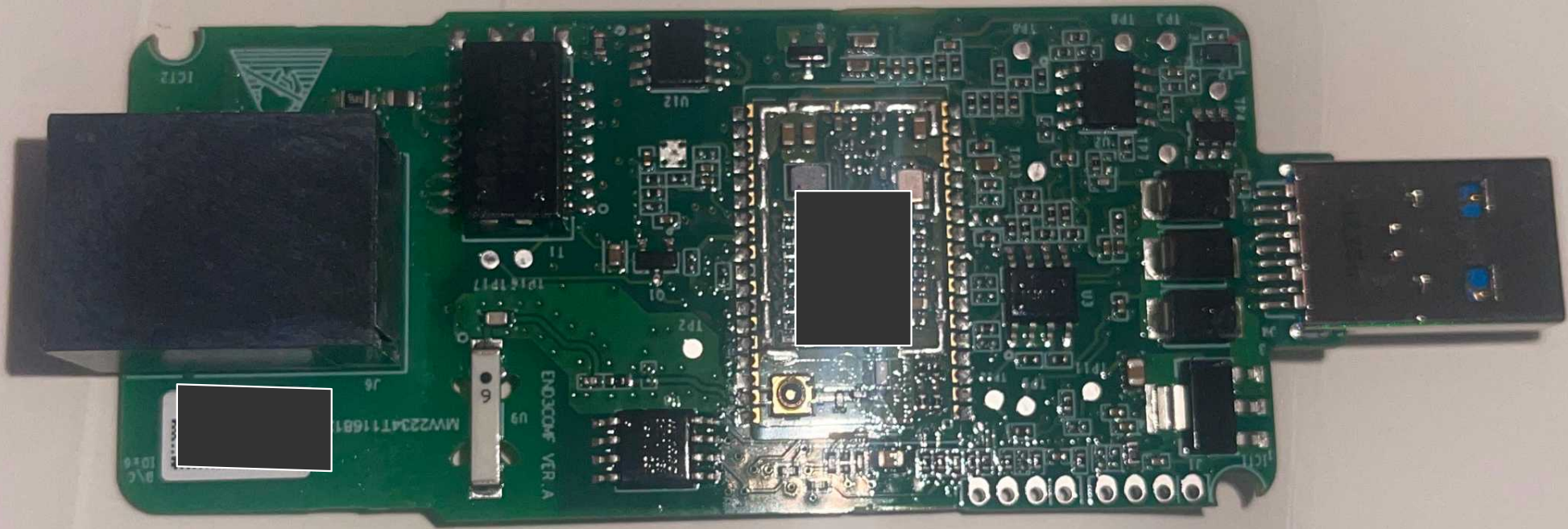
```
"domain": null,  
"ops": [  
  "pvms.realtime.status.query",  
  "pvms.upgrade.defectupgrade.confirm",  
  "pvms.task.inspection.task.list.user.setti",  
  "pvms.homePage.kpi.socialContribution",  
  "pvms.nelog.view",  
  "pvms.user.create",  
  "pvms.task.defect.user.setting",  
  "pvms.systemnote.sending.query",  
  "pvms.devlicense.licenseload",  
  "pvms.default.price.ongrid.query",  
  "pvms.station.singleStation.lavout.createl
```

Back to dongle for a sec











111279A
JOVE JVE-M2 9A
E23294D ▲ 94V-0
16-3



U13

U10

X2

X1

- Dual UART



- Dual UART
- Most likely SSID



```
[user@hostname ~]$ sudo minicom -s
```

```
Welcome to minicom 2.8
```

```
OPTIONS: I18n
```

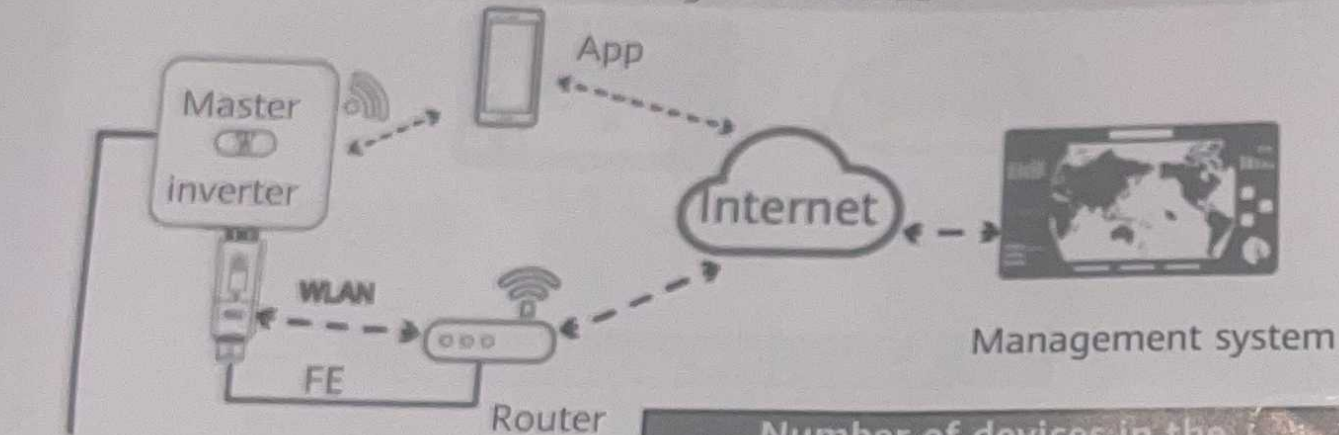
```
Compiled on Jan  9 2021, 12:42:45.
```

```
Port /dev/ttyACM0, 14:02:15
```

```
Press CTRL-A Z for help on special keys
```

```
A4J8 ??A4J8 ??A4J8 ?? ?>A ?>
```

is not disturbed and that the signal is normal.



Number of devices in the RS485 communication scenario

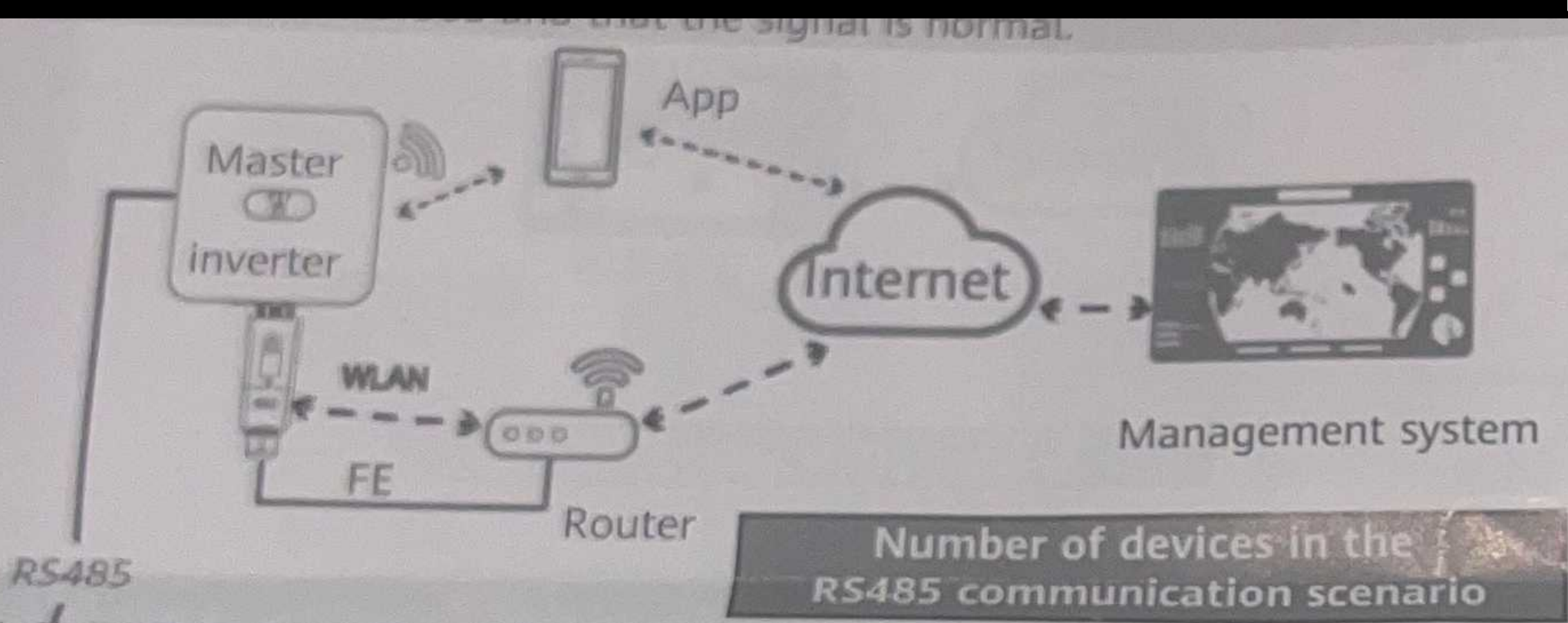
Limited Number	Actual Number	
Maximum number of devices that can be connected to the Dongle	Number of slave inverters	Number of other devices (such as Smart Power Sensor and energy storage devices)
10	$n \leq 9$	$\leq 9 - n$

Devices in the dashed box are optional.

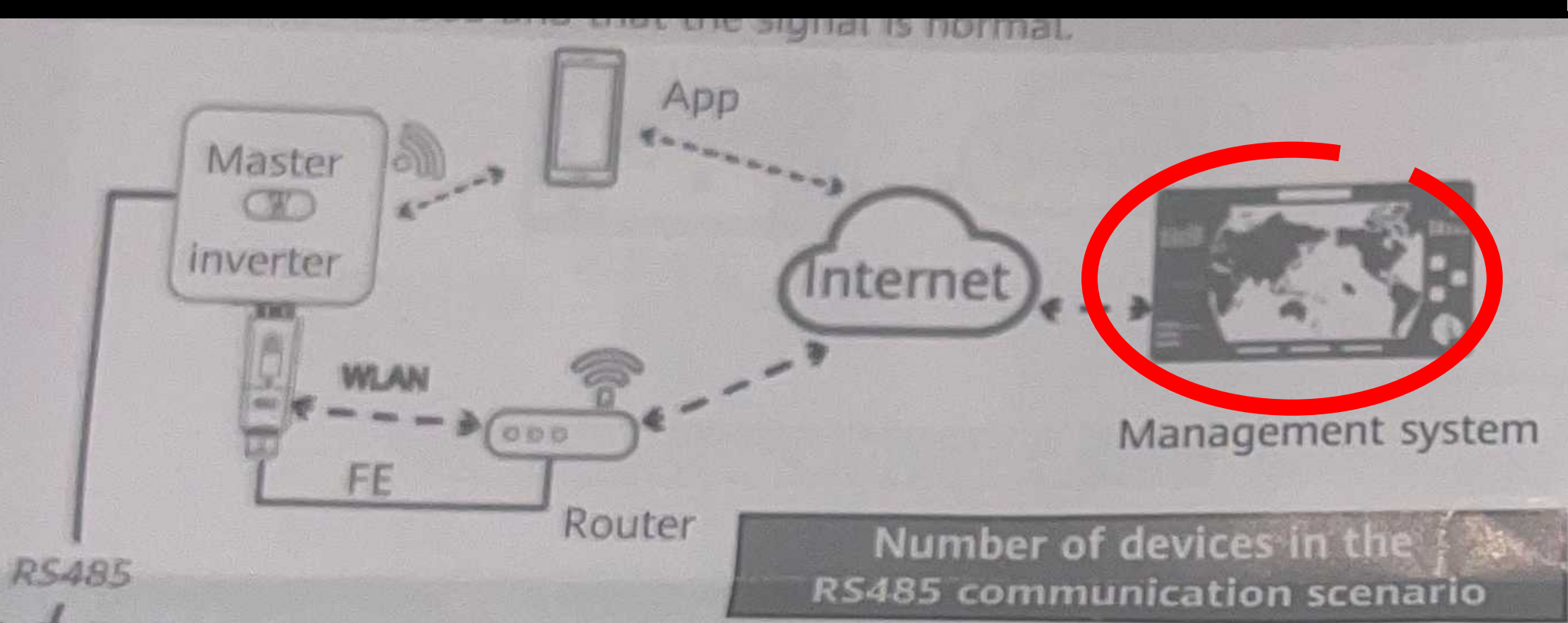
If devices are connected to the 485B2 and 485A2 ports of the master inverter, the devices are not included as cascaded devices.

Inverter Model Requirements

Interesting...



Interesting...



Interesting...

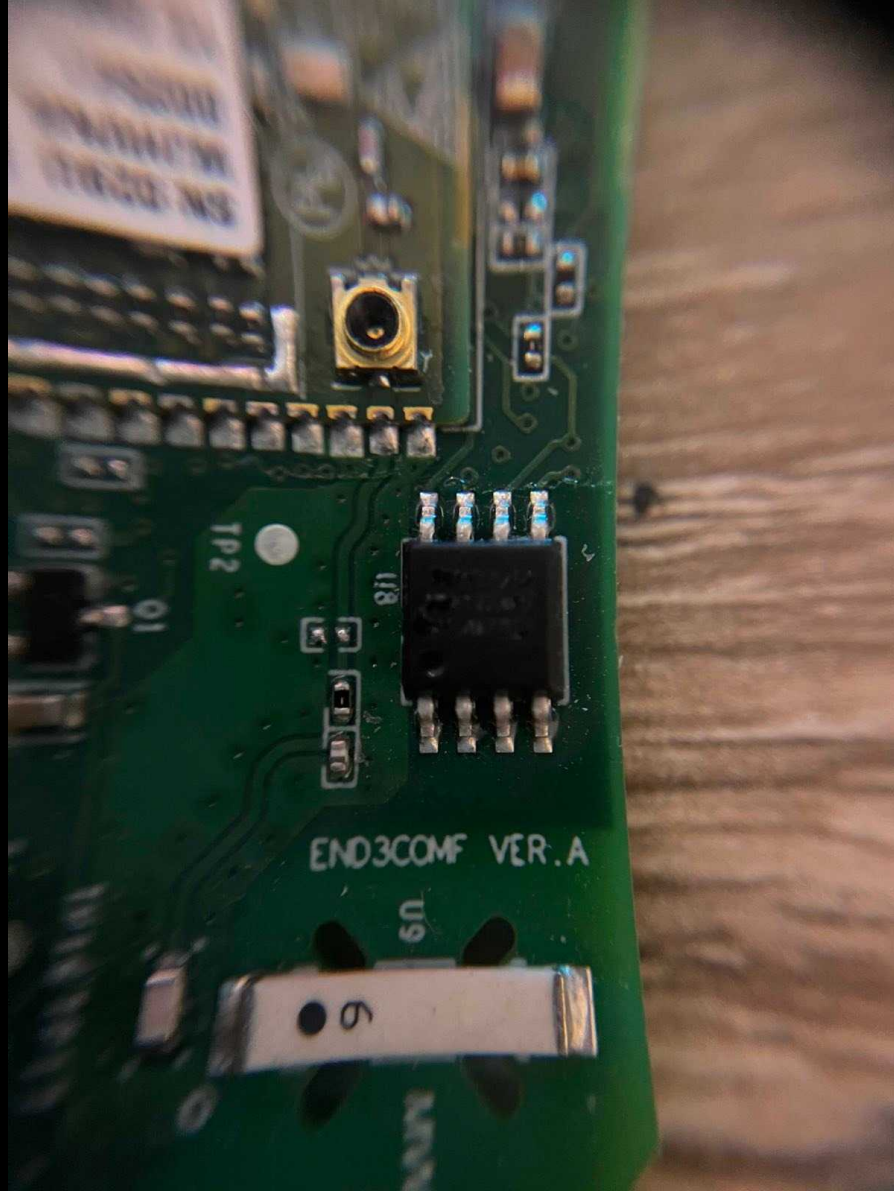
- I for one, would *prefer* to *self-manage* my Decentralized Energy System, rather than use *Huawei's* managed service

Centralized control...

Of a **distributed** energy grid
system...

Thousands of miles away...





UNIVERSITY OF
MICHIGAN
LIBRARY

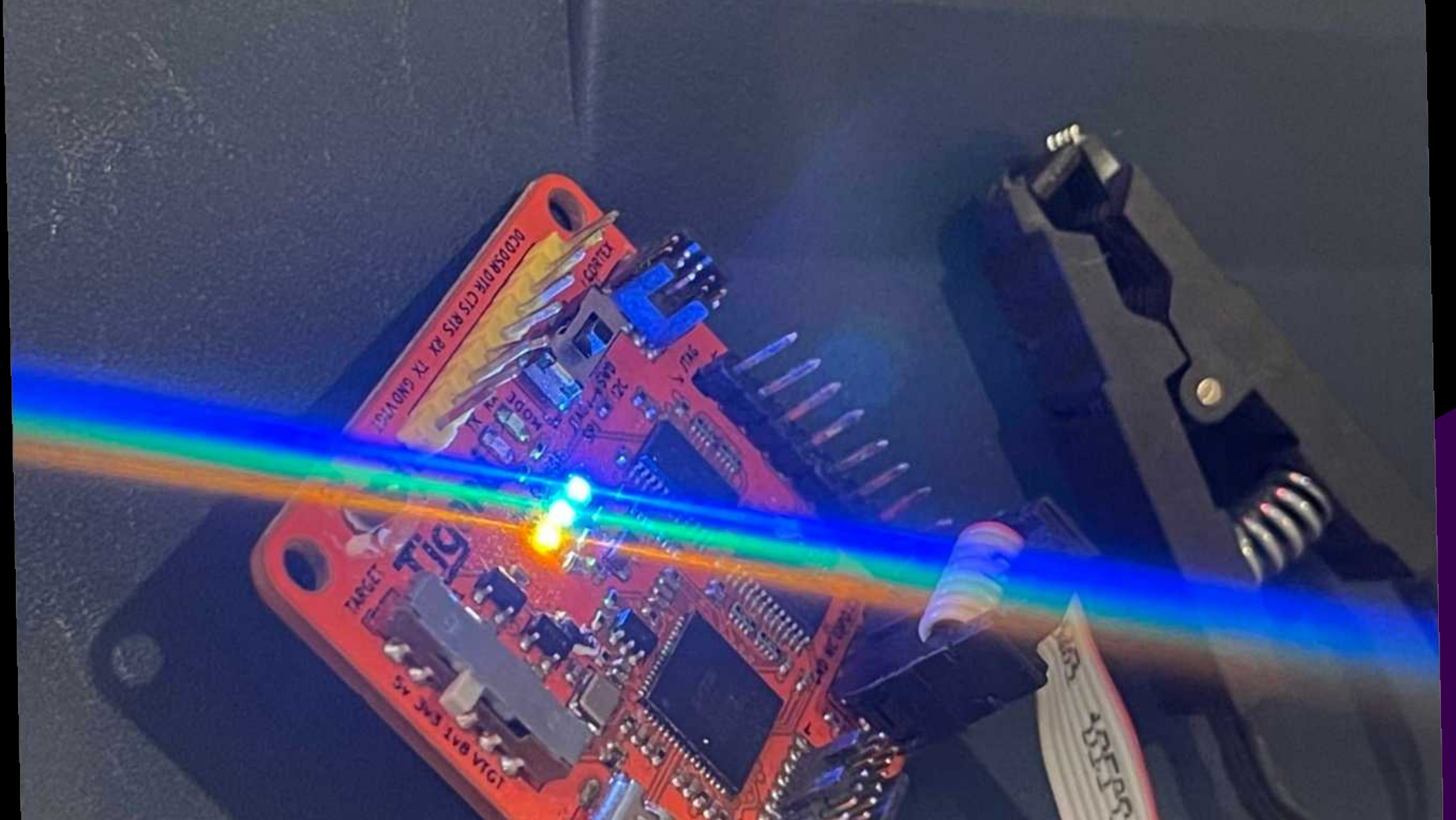
TP2

U18

END3COMF VER. A

U9

5



```
flashrom -p  
ft2232_spi:type=2232H,port=B,  
divisor=4 -c  
'GD25B128B/GD25Q128B' -r  
Huawei_GD25B128B.bin
```

```
flashrom -p  
ft2232_spi:type=2232H,port=B,  
divisor=4 -c  
'GD25Q127C/GD25Q128C' -r  
Huawei_GD25Q127C.bin
```

```
[user@hostname SOLAR-DONGLE]$ ls -lha
total 35M
drwxr-xr-x 2 user users 4.0K Aug 23 16:08 .
drwxr-xr-x 5 user users 4.0K Aug 22 04:48 ..
-rw-r--r-- 1 user users 16M Aug 22 04:47 Huawei_GD25B128B.bin
-rw-r--r-- 1 user users 16M Aug 22 04:47 Huawei_GD25Q127C.bin
-rw-r--r-- 1 user users 2.6M Aug 23 16:08 strings
[user@hostname SOLAR-DONGLE]$
```



```
8706 20140101 000217 M32 sys_equip_wlan_evpcpp990AP 0->2
8707 20140101 000217 M32 sys_equip_fe_base.cpp350SM CC:20:8C:5C:C6:44
8708 21300101 000033 M26 sun_crypto.cpp722D
8709 023>4:0x507
8710 A:2->0,151112
8711 20140101 000214 M32 sys_equip_wlan_evpcpp1403S
8712 20140101 000214 M32 sys_equip_wlan_evpcpp990AP 2->0
8713 20140101 000214 M00 msg_manager.cpp228Q Cnt:0x9,Q023>4:0x507,2014-01-01 00:02:05
8714 20140101 000214 M32 sys_equip_wlan_evpcpp1276AP IP:0XC0A8C801/0XFFFFFF00
8715 sun_ca.crt
8716 sun_ca.crt
8717 -----BEGIN CERTIFICATE-----
8718 MIIEvTCCAqWgAwIBAgIRdk1bW1D+hiZ4r/hzTNVpTzswDQYJKoZIhvcNAQELBQAw
8719 PDELMakGA1UEBhMCQ04xDzANBgNVBAoTBkh1YXdl aTEcMBoGA1UEAxMTSHVhd2Vp
8720 IEVxdWlwbWVudCBDQTAeFw0xNjEwMTgwNjUxMzdaFw00MTEwMTIwNjUxMzdaMEkx
8721 CzAJBgNVBAYTAkNOMQ8wDQYDVQQKEwZIdWF3ZWkxKTAnBgNVBAMTIEh1YXdl aSBO
8722 ZXR3b3JrIEVuZXJneSBQcm9kdWN0IENBMIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8A
8723 MIIBCgKCAQEAtGP+9+pYAvnh55EaUumBRQyGpDRMqBnWS9YJaRisfSI2rqkyaOro
8724 UOmVtR6FEptMtOGTtIptcUnW8y+i8vc9PjPS6v2E45kmiJrQM4adiFz7YHAISbiI
8725 D40wJctZP29hCQRffZMsbYkDddJvq3Jgf/xahxzpCHlqOxCsd02RKkxtCbQDqcO
8726 8XDetvx11wBn+vNL3TXENL1DWmIcJnePzZGR5GHGSUigpWTxnGiK/8ORoAP7t+Dw
8727 15wwin734mq9appXv920AcBp0iGegtWclhh5tqbAZ1TDbmHWzkORBK1u6yJh281z
8728 pxU118heHdWVcpAV39aH42WO8dL4dkkZpwIDAQABo4GsMIGpMB8GA1UdIwQYMBaA
8729 FCr4EFkngDUfp3y6O58q5Eqqm5LqMEYGA1UdIAQ/MD0wOwYEVROgADAzMDEGCCsG
8730 AQUFBwIBFiVodHRwOi8vc3VwcG9ydC5odWF3ZWkuY29tL3N1cHBvcnQvcGtpMA8G
8731 A1UdEwQIMAYBAf8CAQAwDgYDVR0PAQH/BAQDAgEGMB0GA1UdDgQWBRRRub8fduv
8732 NWeK0BbESTq5xq5VSDANBgkqhkiG9w0BAQsFAAOCAgEA
8733 bHDK586vYT8YPSMc/c7q
8734 sh5BWXtL4gI5geMYXc3fr07gfEsOCKaymmzeT9O9Vl92unzGRZpNmRWsFKzwNAIAd
```

```
18712 20140101 000214 M32
18713 20140101 000214 M00
18714 20140101 000214 M32
18715 sun_ca.crt
18716 sun_ca.crt
18717 -----BEGIN CERTIFICA
18718 MIIEvTCCAqWgAwIBAgIF
18719 PDELMAkGA1UEBhMCQ04x
18720 IEVxdWlwbWVudCBDQTAe
18721 CzAJBgNVBAYTAkNOMQ8w
```



```
8773 HSD+urwYL+KvgdDa6kEkW0jNSj6k8L8/3v2UpSC986YLnO
8774 Rvm02F/ivRwtUjkSAcx+kWFZSvbFPTjCCmgdYPZ2FMZA0L
8775 4c1S0RuN3m/76xo=
8776 -----END CERTIFICATE-----
8777 BQUHMAKGHGh0dHA6Ly8xMjcuMC4wLjEvY2Fpc3N1ZS5odG
8778 Fmh0dHA6Ly8xMjcuMC4wLjE6MjA0NDMwDQYJKoZIhvcNAQ
8779 Tmbxl+doRdljxo+YidPK+wOiCDsNv1FX
8780 sun_tomcat_client.key
8781 |sun_tomcat_client.key
8782 -----BEGIN RSA PRIVATE KEY-----
8783 Proc-Type: 4, ENCRYPTED
8784 DEK-Info: AES-256-CBC, 2992EA3236C3A436B8958438
8785 SoLzUpFsK7c6aYOSpFrdoVL04yLd1HubpBXU9EFJ+KQo5p
8786 8MZMxqqUUYKIKygwaxmgzsVV5FRkKsxUn+qVLqB/5wFCXy
8787 ChXgB0BLY7hK4AuHspNngQ5VCuQ2jlijQsxRFa5T5RRu6H
8788 9UzF7qODuMZY6gsSZ7LnC0oBWONW7SuCiZA6FPL9MgVwMx
8789 15vDDuvClEVGamazrBUYwS3J2W+c+iZqP6uS9AA7tsznik
```

```
26937 20140101 000000 M23 sun_mb_tcp  
0:00:0  
26938 eqmg_equip_b0150001.emap  
26939 SDongleA-HV22A0037605  
26940 SUN2000-024JHJ10HC001535  
26941 F/|T  
26942 eqmg_equip_b0150001.emap  
26943 SDongleA-HV22A0037605  
26944 SUN2000-024JHJ10HC001535  
26945 F/|T  
26946 eqmg_equip_b0150001.emap  
26947 SDongleA-HV22A0037605  
26948 SUN2000-024JHJ10HC001535  
26949 F/|T  
26950 eqmg_equip_b0150001.emap  
26951 SDongleA-HV22A0037605  
26952 SUN2000-024JHJ10HC001535
```

```
12874 WlanRespIwpCmd
12875 WlanRespHiprivInitCmd
12876 WlanRespHiprivCmd
12877 WlanRespAtptCmd
12878 WlanRespGetIp
12879 WlanRespRecv
12880 WlanRespClose
12881 WlanRespShutdown
12882 WlanRespGetPeer
12883 WlanRespGetSock
12884 WlanRespSelect
12885 WlanRespIoctl
12886 WlanRespFcntl
12887 WlanRespWlanCtl
12888 WlanGetHeadNode
12889 WlanDealCmdResp
```

WlanRespWlanInit	WlanCtlRespStaStartDhcp
WlanCtlRespApStart	WlanCtlRespStaStopDhcp
WlanCtlRespGetLog	WlanCtlRespGetMac
WlanCtlRespApStop	WlanCtlRespGetApMac
WlanCtlRespApGetStatus	WlanCtlRespSetEdmacRegionCode
WlanCtlRespApGetStaNum	WlanCtlRespUartUpgrade
WlanCtlRespStaStartScan	WlanCtlRespSdioUpgrade
WlanCtlRespStaGetScanApNum	WlanCtlRespBaudNego
WlanCtlRespStaGetScanInfo	WlanCtlRespArpTableCmd
WlanCtlRespStaConnect	WlanCtlRespRouteTableCmd
WlanCtlRespStaDisconnect	WlanCtlRespPingCmd
WlanCtlRespStaGetStatus	WlanRespDbg
WlanCtlRespStaGetRssi	WlanRespMac
WlanCtlRespApSetHostAddr	WlanRespHand
WlanCtlRespApSetNetwork	WlanRespDnsSetSvr
WlanCtlRespStaSetHostAddr	WlanRespDnsGetSvr
WlanCtlRespStaSetNetwork	WlanRespDataLen
WlanCtlRespStaSetGateway	WlanRespAtTest
WlanCtlRespApGetHostAddr	WlanRespVer
WlanCtlRespApGetNetwork	WlanRespSetSockOpt
WlanCtlRespStaGetHostAddr	WlanRespGetSockOpt
WlanCtlRespStaGetNetwork	WlanRespSocket
WlanCtlRespStaGetGateway	
WlanDealCmdResp	

WlanRespIwpCmd
WlanRespHiprivInitCmd
WlanRespHiprivCmd
WlanRespAtptCmd
WlanRespGetIp
WlanRespRecv
WlanRespClose
WlanRespShutdown
WlanRespGetPeer
WlanRespGetSock
WlanRespSelect
WlanRespIoctl
WlanRespFcntl
WlanRespWlanCtl
WlanGetHeadNode

WlanRespConnect
WlanRespListen
WlanRespBind
WlanRespSend
WlanRespSslCtl
WlanRespArpCmd

RATWINIT

RATWCTL

RATTSET

RATTGET

RATSOCKET

RATCONNECT

RATBIND

RATSEND

RATRECV

RATCLOSE

RATACCEPT

RATSHUTDOWN

RATGETPEER

RATGETSOCK

RATSELECT

RATIOCTL

ATFCNTL

RATCNTL

RATLISTEN

RATSSLCMD

RATARP

riwpriv

RATPT

RATIP

RATVER

RATDBG

RATMAC

RATHAND

RATDNSSVR

RATLEN

RATTEST

RATPRIVINIT

```
0226 17CModbusTCPAppMgrL
0227 17CModbusUSBPortMgr
0228 17LocalModbusTcpMgr
0229 25CModbus485PortMgrSUN2000L
0230 25CModbusTCPRemoteSeverMgrL
0231 V100R001C00
0232 /usr1/workspace/SDongle_C9X_HC/src/dongle/bpl/update
update_delay_active_fe.cpp
0233 dly [%#x]
0234 file%d[%#x]
0235 reboot 2 %#x
0236 dly act
```

Interesting

- Nowhere to “confirm” on dongle.
- Receives updates without prompt.
- Can be updated without permission

Centralized

- If Huawei suffers a **breach**.
- Someone can **brick** every single inverter in the **world**.

Final stretch Threat modeling



EPRI 3420 Hillview Avenue, Palo Alto, California 94304 | 800-313-3774

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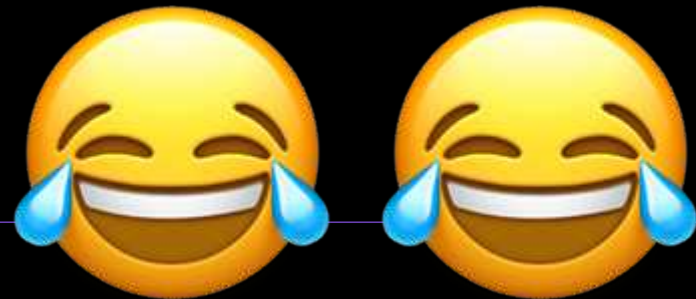
TOGETHER...SHAPING THE FUTURE OF ENERGY®

Distributed, inverter-based systems

- As we migrate from a **centrally controlled, synchronous generator-based grid** to a **highly distributed, inverter-based system**

Distributed, inverter-based systems

- As we migrate from a **centrally controlled, synchronous generator-based grid** to a **highly distributed, inverter-based system**
- *Lol jk, it's centrally controlled bro*




Localized failures



 PV Magazine
Fire accident at Argentinian solar park ...




 Phoventus
Inverter Failure Forensic...




 inverter.com
Fire Safety of Photovoltaic System ...



 sunhive.com
PV Fire, the inevitable?!...



 Solar Power Portal
Fire safety risks – and their solutions ...




 The Courier Mail
Fire victim warns of solar panel threat ...



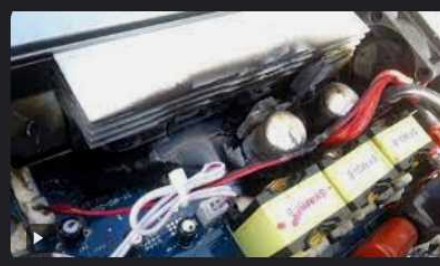
 AC Solar Warehouse
Solar fires




 PV Magazine
rooftop PV systems from fire risk ...




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 YouTube
Inverter failure and fire - warning to ...




 FireRescue1
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 Twitter
Royston Fire Station on ...




 DatacenterDynamics
OVHcloud SBG2 fire report reveals water ...



 Punch Newspapers
Fire destroys finance ministry's ...




 EEVblog
Dodgy solar regulators catch...



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Solar fires



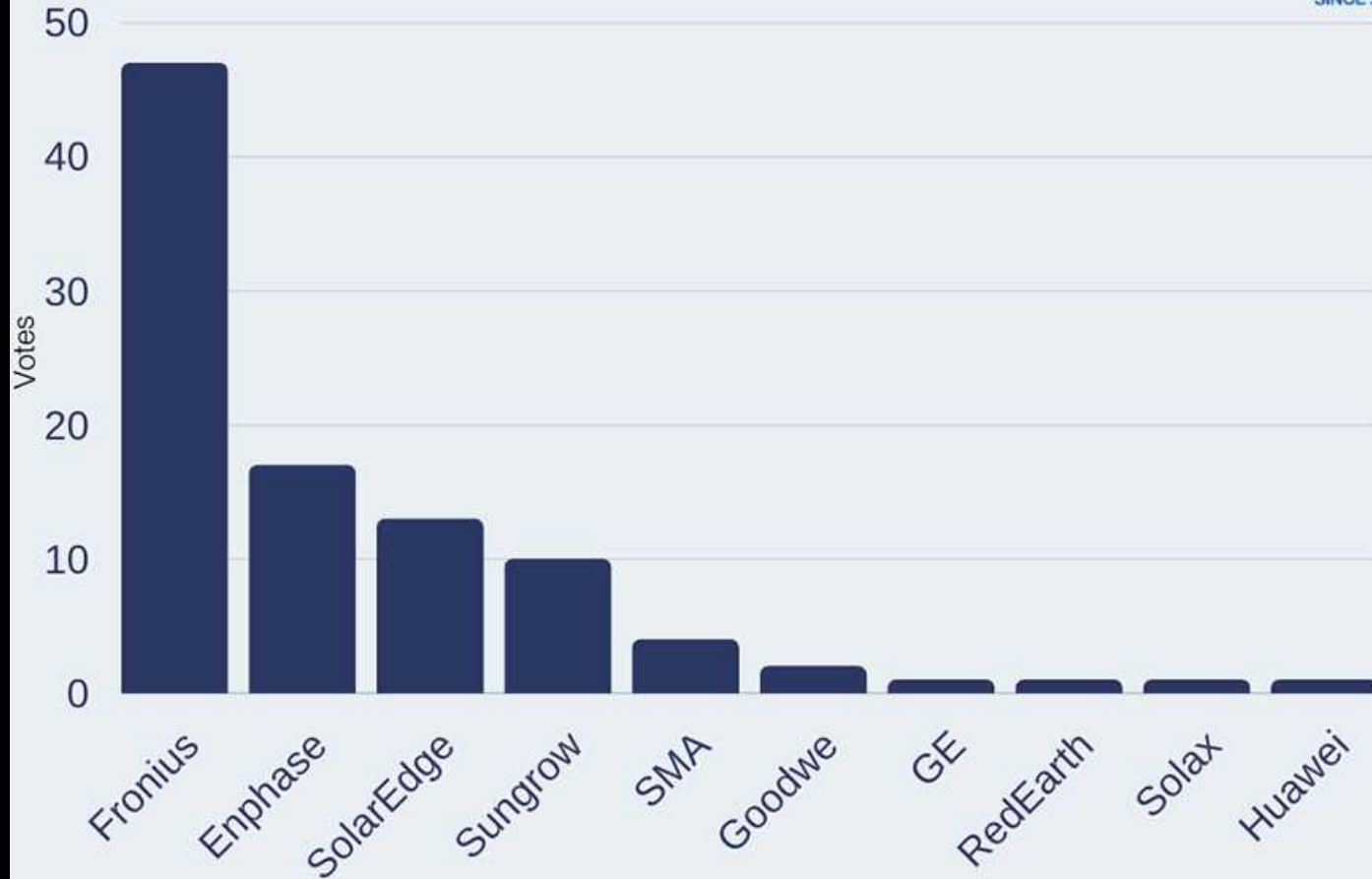
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Best Inverters

Installers' Choice 2023



Catastrophic activity

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- Centralized control of an entire brand

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- Disabling all brand via monitoring panel, at once

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- Load Shedding induced
- Power out

We are currently **LOAD SHEDDING** in **STAGE 6** in some areas due to high demand or urgent maintenance being performed at certain power stations

If you are a **DIRECT ESKOM CUSTOMER** click [HERE](#) to view load shedding schedules

If you are a **MUNICIPAL CUSTOMER** click [HERE](#) to view load shedding schedules

Power Alert: 19 February 2023

Due to the breakdowns of eight generation units on Sunday afternoon, Stage 6 loadshedding will be implemented continuously until further notice.

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Different causes, same outcome:

- Damage caused by overload on distributor

Different causes, same outcome:

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- Breaker trips

Different causes, same outcome:

- Damage caused by overload on distributor
- Breaker trips
- Cable theft

E.g. South Africa **crisis**

- Load shedding

<https://www.eskom.co.za/due-to-the-breakdowns-of-eight-generation-units-on-sunday-afternoon-stage-6-loadshedding-will-be-implemented-continuously-until-further-notice/>

E.g. South Africa **crisis**

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E.g. South Africa **crisis**

- Load shedding
- Burning diesel to meet demand too expensive
- Coal fired plants maintenance/off
- Generating unit repairs
- Undersupply of coal

<https://www.eskom.co.za/due-to-the-breakdowns-of-eight-generation-units-on-sunday-afternoon-stage-6-loadshedding-will-be-implemented-continuously-until-further-notice/>

Under capacity



Due to the breakdowns of eight generation units on Sunday afternoon, Stage 6 loadshedding will be implemented continuously until further notice

● February 21, 2023

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Unit 2 of Koeberg Nuclear Power Station back in service" >**Unit 2 of Koeberg Nuclear Power Station back in service**

● February 18, 2023

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Loadshedding will be implemented at Stages 3 and 4 during the week

● February 12, 2023

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So, can you induce Load Shedding?

So, can you induce Load Shedding?

- Answer should be pretty clear

Solar PV capacity by country and territory (MW) and share of total electricity consumption[[view/edit](#)]

Country or territory	2016 ^[8]		2017 ^[18]		2018 ^{[19][20]}		2019 ^{[21][22]}		2020 ^{[23][24]}		2021 ^{[25][26]}		W per capita	W per capita	Share of total consumption ¹
	New	Total	New	Total	New	Total	New	Total	New	Total	New	Total			
 Honduras		414		451		485		511		514		514	53	53	12.9% (2020) ^[23]
 Australia	839	5,900	1,250	7,200	3,800	11,300	3,700	15,928	1,699	17,627	1,449	19,076	637	742	10.7% (2020) ^[23]
 Germany	1,520	41,220	1,800	42,000	3,000	45,930	3,900	49,200	4,583	53,783	4,678	58,461	593	702	9.7% (2020) ^[23]
 Greece							2,652	2,763	484	3,247		3,530	258	329	9.3% (2020) ^[23]
 Chile	746	1,610	668	1,800	337	2,137	511	2,648	557	3,205	1,263	4,468	142	234	9.1% (2020) ^[23]
 Spain ^[27]		4,669	19	4,688	19	4,707	4,004	8,711	5,378	14,089	1,863	15,952	186	237	9.0% (2020) ^[23]
 Netherlands	525	2,100	853	2,900	1,300	4,150	2,575	6,725	3,488	10,213	4,036	14,249	396	817	8.9% (2020) ^[23]
 Japan	8,600	42,750	7,000	49,000	6,500	55,500	7,000	63,000	4,000	67,000	7,191	74,191	498	590	8.3% (2020) ^[23]
 Italy	373	19,279	409	19,700	420	20,120	600	20,800	800	21,600	1,098	22,698	345	381	8.3% (2020) ^[23]
 Belgium	170	3,422	284	3,800	226	4,026	505	4,531	1,115	5,646	939	6,585	394	569	6.6% (2020) ^[23]
 India	3,970	9,010	9,100	18,300	10,800	26,869	9,900	35,089	4,122	39,211	10,473	49,684	32	36	6.5% (2020) ^[23]

Country or territory	Net	Share of total consumption ¹
 Honduras	3	12.9% (2020) ^[23]
 Australia	2	10.7% (2020) ^[23]
 Germany	2	9.7% (2020) ^[23]
 Greece	9	9.3% (2020) ^[23]
 Chile	4	9.1% (2020) ^[23]
 Spain ^[27]	7	9.0% (2020) ^[23]
 Netherlands	7	8.9% (2020) ^[23]
 Japan	8	8.3% (2020) ^[23]
 Italy	1	8.3% (2020) ^[23]
 Belgium	9	6.6% (2020) ^[23]

Distributed Energy Cyber Attack

<https://www.energy.gov/eere/femp/severe-weather-resilience-solar-photovoltaic-system-design>

Distributed Energy Cyber Attack

- Unaffected by weather

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Distributed Energy Cyber Attack

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- Reliance on overseas technology

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- Catastrophic consequences
- Reliance on overseas technology
- Trust in insecure products

<https://www.energy.gov/eere/femp/severe-weather-resilience-solar-photovoltaic-system-design>

- **Unaffected by weather**
- **Catastrophic consequences**
- **Reliance on overseas technology**
- **Trust in insecure products**
- **Little to no assessment**

<https://www.energy.gov/eere/femp/severe-weather-resilience-solar-photovoltaic-system-design>

Thank you

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