NASEO
National Association of State Energy Officials

NARUC
National Association of Regulatory Utility Commissioners

NASEO-NARUC Microgrids State Working Group Webinar: Innovative Microgrid Project Designs

March 29, 2023

Speakers

- Shelly Peterson, Program Manager, Iowa Economic Development Authority
- Anne Kimber, Director, Electric Power Research Center, Iowa State University
- Armando Infanzon, Director- Business Development, Clean Energy Innovations, SoCalGas

economic development

Mobile Microgrid Project

Iowa Energy Office with Iowa State University | March 29, 2023

Iowa Economic Development Authority | Iowa Energy Office
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Energy Office Microgrid Project

- SEPF award of $125,00 (Jan. 2021-Aug. 2022) and SEP ARRA legacy grant program award of $180,00 (June 2019-Dec. 2020)
  - Amended SEPF scope in 2022 to add funds
  - Awards to state university are a simpler procurement pathway

- Partners: Iowa State University, SunCrate; PowerFilm, Iowa Army National Guard
  - IEDA helped create the “marriage” of these partners

Energy Office Microgrid Project

Scope:

- assemble crate (commercially available components)
- design specs, economic analysis
- architectural concept for mobile command center
- stakeholder review committee
- use case analyses
- interconnection analysis
- battery reliability and life-time study
- pallet-sized unit
- whitepaper
- operating instructions and videos

Energy Office Microgrid Project

Scope: Sometimes you need more than a report!

- Project demonstrations
  - public
  - utilities
  - IEDA food truck day
  - emergency managers

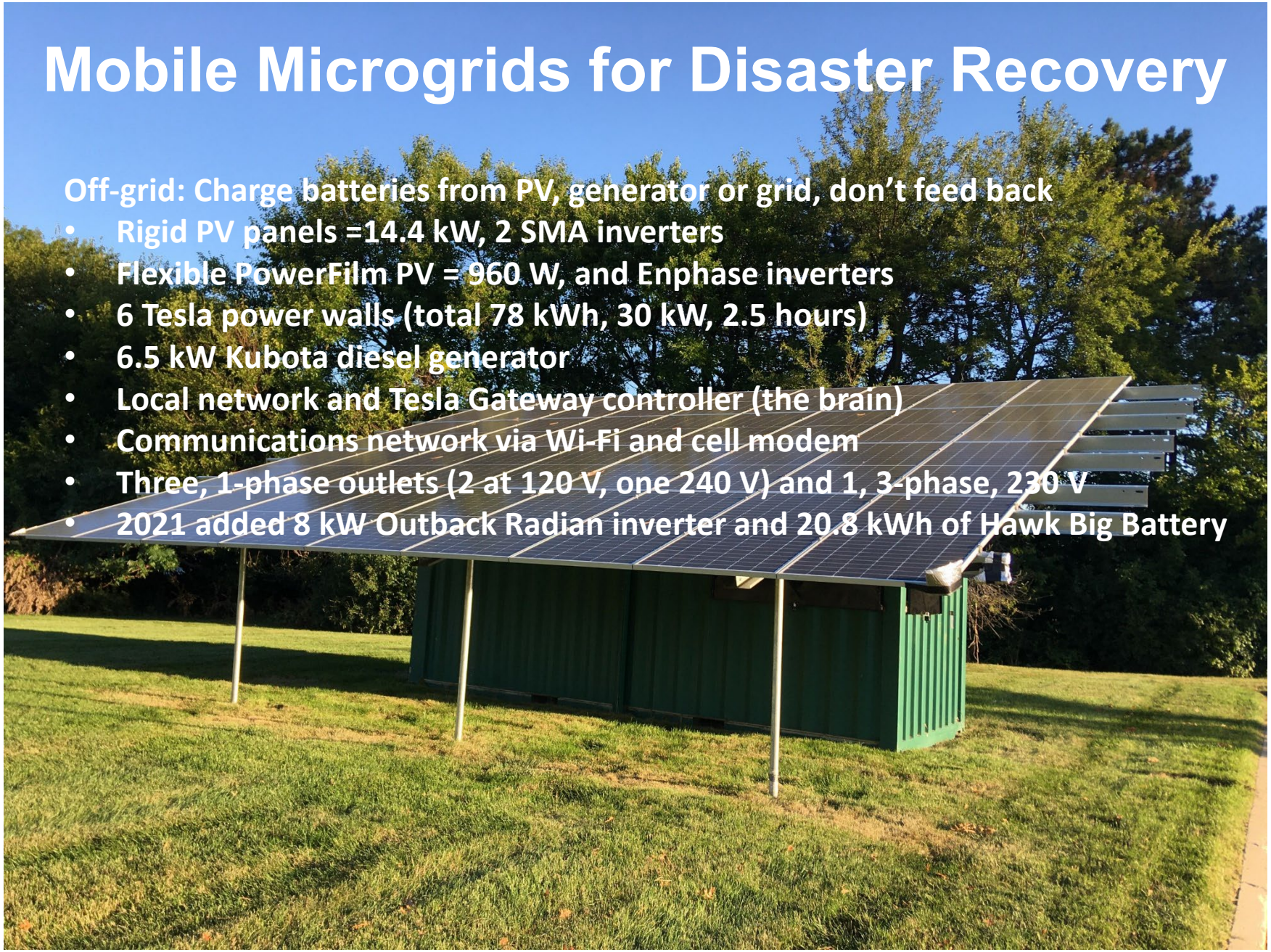
Energy Office Microgrid Project Takeaways

- Invest in projects that result in spin-off opportunities
  - Sandia Lab relationship; utility-scale fixed battery project with utility partner; state emergency management agency collaboration; demonstration of mobile system at remote wastewater lagoon supports new wastewater treatment technology supported by another IEDA grant program
- Align with the State Energy Plan
  - Utilize smart grid and other technologies to modernize Iowa's electricity systems; foster innovation; strengthen energy education and awareness; promote training opportunities
- Publicize the effort
  - Webinars, ISU engineering newsletters, EPRC meetings, website case study, photos, demos

Energy Office Microgrid Project Takeaways

- Create public/private partnerships
  - Involve multiple partners for greatest impact and to promote economic development
- Capture lessons learned
  - Need to make power visible to the people
  - Learn how to tell the microgrid story to various audiences
  - Build upon the success and keep up the dialogue

Mobile Microgrids for Disaster Recovery



Off-grid: Charge batteries from PV, generator or grid, don't feed back

- Rigid PV panels =14.4 kW, 2 SMA inverters
- Flexible PowerFilm PV = 960 W, and Enphase inverters
- 6 Tesla power walls (total 78 kWh, 30 kW, 2.5 hours)
- 6.5 kW Kubota diesel generator
- Local network and Tesla Gateway controller (the brain)
- Communications network via Wi-Fi and cell modem
- Three, 1-phase outlets (2 at 120 V, one 240 V) and 1, 3-phase, 230 V
- 2021 added 8 kW Outback Radian inverter and 20.8 kWh of Hawk Big Battery

Anne Kimber, EPRC Director,

Nicholas David, EPRC Engineer

Dolf Ivener, SunCrate

Dan Stieler, PowerFilm

Col. John Perkins
Ken Thornton
Iowa Army National Guard

https://www.ece.iastate.edu/eprc/

IOWA STATE UNIVERSITY
Electric Power Research Center

IOWA economic development

PowerFilm SOLAR MADE IN THE USA

SunCrate

IOWA NATIONAL GUARD

Background: IEDA project: mobile microgrid for disaster recovery

SunCrate solar/storage crate to Puerto Rico (w/ Black & Veatch)

PowerFilm Inc. flexible solar materials, military applications.

Iowa Army National Guard (IA ANG) provide design requirements for crate performance, contribute expertise on applications.

ISU Architecture, Electrical Engineering, Mechanical Engineering profs and students: solar house design/build, battery modeling and testing, microgrid design

Advisory Committee: IA ANG, Alliant, City of Ames, Cedar Falls Utilities, MidAmerican Energy

Earlier microgrid: Solar crate in Puerto Rico, August 2018

Phase 1 Tasks:

- **Design, build, deliver:** mobile microgrid for disaster recovery, to IA ANG requirements
- Provide plans for a *second* crate to serve for human use as office, or housing, based on ISU solar decathlon experience

Phase 2 Tasks: Demonstrate, collaborate and improve the microgrid based on feedback from microgrid advisory committee, Iowa Dept. Homeland Security, County Emergency Managers


Camp Dodge soldiers packing up crate: removing PV panels


removing beams


Panels and beams fit inside crate

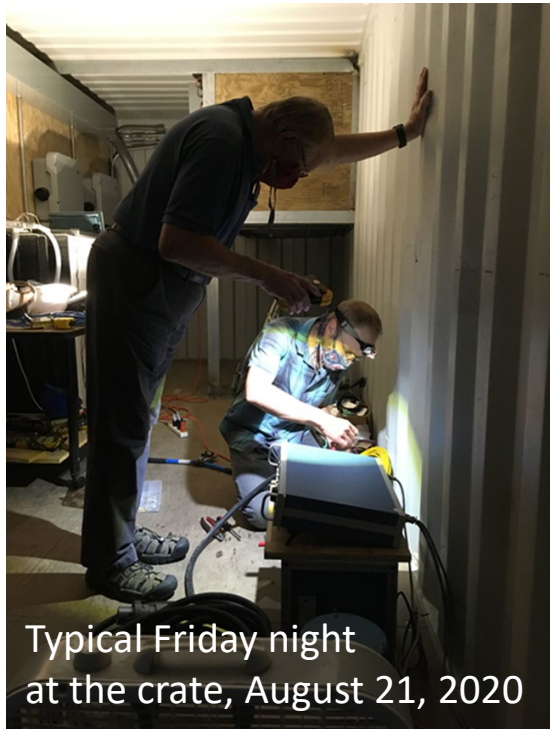

reassembly at Camp Dodge


reassembly at Camp Dodge, note 48” anchors


Aligning PV panels

Why build a mobile microgrid in Iowa?

- ISU power group research and expertise in distributed energy systems and storage, focus on mobile, modular systems
- Leadership and funding from IEDA to develop an applied demonstration project for future resiliency benefits
- “People power” of the team: determination, ingenuity, flexibility, hard work and shared vision for success
- Vision, common purpose among organizations for a practical “seed” project, to lead to greater applications
- Challenge from the IA ANG: single phase and 3 phase, include diesel generator, power a typical gasoline pump.
- Public and agency interest increased after August 10, 2020 Derecho long-duration power outages:


Typical Friday night at the crate, August 21, 2020


7 am February 22, 2021


Tesla charging at the crate after the Derecho


Charging devices and cooking breakfast August 11, 2020

Idea of rapid deployment of mobile microgrids for community resiliency hubs

Idea: Mobile microgrids as "Grid Resilience Assets" to power:

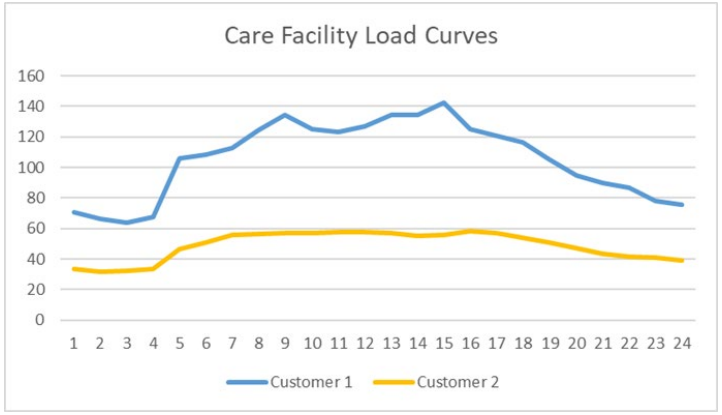
-gas stations
-city hall or community center, red cross shelters, daycares
-critical circuits in grocery stores
-cell towers and communication infrastructure,
-nursing home or health care facilities,
-food trucks, mobile kitchens,
-mobile command center
-water treatment and distribution pumping
-wastewater collection, treatment, discharge

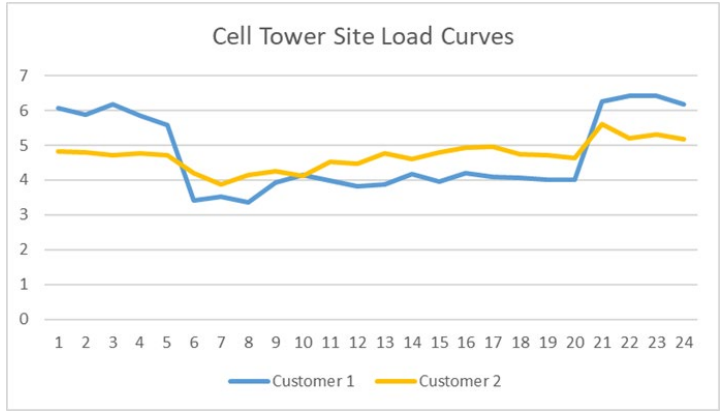
"daisy-chained" plug and play systems

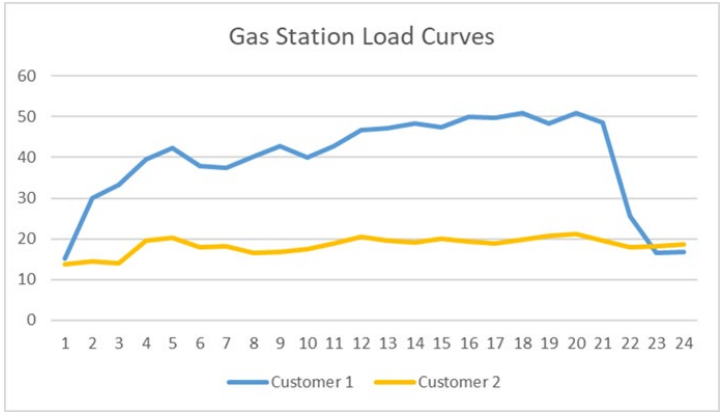
Delivered fully charged: immediate power supply for utility and community resource

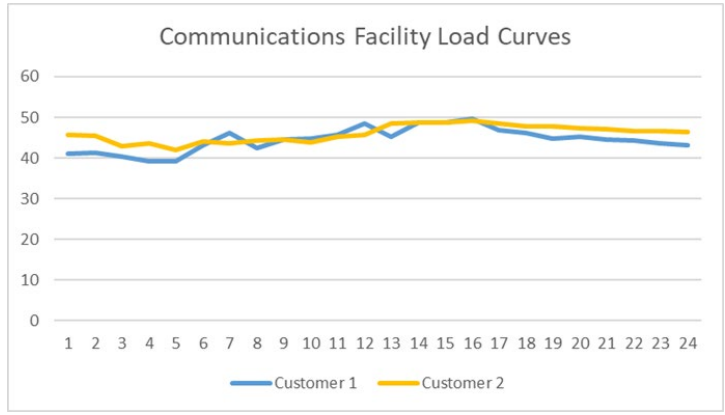
Microgrid Design challenges:
Load characteristics (use cases): demand kW, energy kWh, duration (few hours, to weeks)
Resources: Solar, wind, battery, diesel generation mix depend on solar/wind resource, fuel supply
Other: portability, ease of use, budget, communications and control
Design tools: REopt and Hybrid Optimization and Performance Platform (HOPP, NREL)

Summer peak day demand profiles for critical customer loads (load data from Iowa utility):









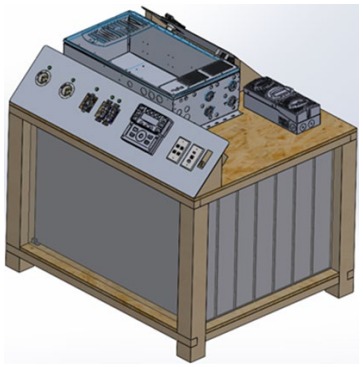
ISU Mobile microgrid outcomes:

The first microgrid has been used to:

- Power wastewater treatment in Dow City IA with BES Water Solutions
- Interconnect to grid (in process) to provide power to swine barn at ISU Ag student farm for teaching.
- Design “sister microgrid” to power offgrid construction trailer in AZ
- Microgrid demonstration for NSF grant (PI Yu Wang, Poli Sci), for public education and to survey public interest and acceptance

New projects:

- 2023 project: Iowa Energy Center grant to design/build: crate with pallets to meet 3, 6, 10 kW loads. for wastewater treatment
- IEDA funds used to build 2, “plug and play” *pallet*-microgrids (per IA ANG directive for “daisy chain” smaller modular, portable systems (4’ cubes, planned for 100 kWh storage)



More ISU Mobile microgrid outcomes:

- Successful FEMA BRIC scoping application, with IDHS, IEDA, advisory team to site, design, build microgrids for Iowa community resiliency
- Continued research and training collaborations with DOE National Labs (Idaho, Sandia, Pacific Northwest, and NREL) on the **MIRACL** project (**M**icrogrids, **I**nfrastructure **R**esilience and **A**dvanced **C**ontrols **L**aunchpad), on the **D3T** project (Defense and Disaster Deployable Turbine), on **Wind for Rural Load Centers**, and for microgrid training through webinars.
- Series of webinars on Microgrids and Energy Storage for resilience, with DOE Energy Storage, Organization of MISO States, FEMA and Sandia National Laboratory (April 12, 19, 26, May 3, 2023):

  https://energy.sandia.gov/programs/energy-storage/policy-and-outreach/regulatory-webinars/fema-webinar-series
- ISU senior design teams and graduate students continue to use the original microgrid as starting point for their microgrid designs and data analyses. (Electric Power Research Institute (EPRI) GridEd grant for undergrad student R&D).

ISU FEMA BRIC-2021-IA-0009, scoping grant 2023-2024

Title: Flexible renewable power sources for greater Iowa community resiliency

Purpose: Develop computational tool to size and site local energy resources and distribution lines to strengthen the energy lifeline for Story County communities. **Outcome:** Use tool to plan projects justifiable for FEMA BRIC funding.

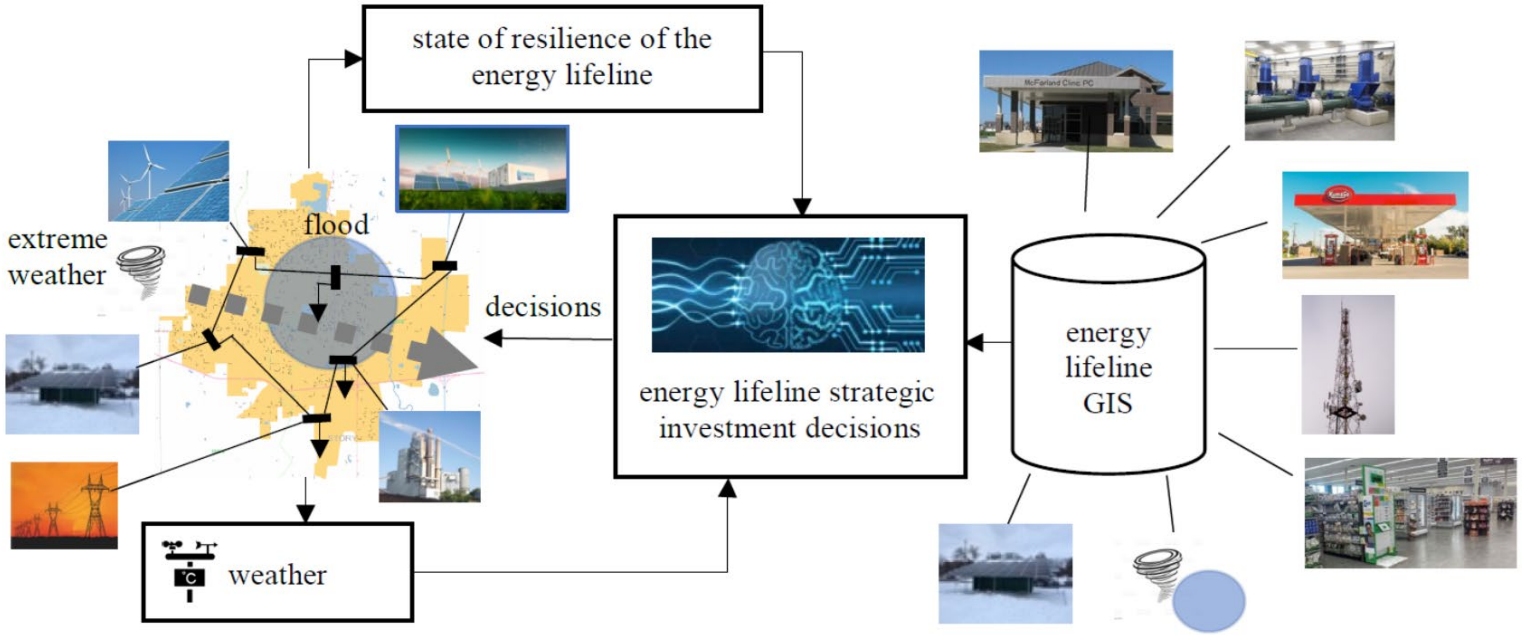


Fig. 2. Concept of the functionality of the project. The brain maps inputs into strategic investment decisions.

Evolution of microgrids during our project

- Standards:
  - IEEE 1547, Rule 21
  - Tactical microgrid standard (MIL-STD-3071) released March 2023, https://quicksearch.dla.mil/qsDocDetails.aspx?ident_number=285095
  - Sunspec Modbus communications protocols
- Technologies such as SEL microgrid controller (Schweitzer) and microgrid-ready generators running on hybrid fuels
- Importance of plug and play operation for ease of operation
- Utilities building microgrids and investing in energy storage
- More technology options for battery and inverter systems
- FERC Order 2222 for distributed resources access to markets
- Critical load mapping resources through NREL assistance
- Microgrid resources available through the work of NARUC and NASEO

[H2] Innovation Experience:

Enhancing California's Energy Resilience and Reliability

NASEO-NARUC Microgrids State Working Group Webinar:
Innovative Microgrid Project Designs

March 29, 2023

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The Opportunities

Decarbonization While Maintaining Reliability

Achieve California's climate & air quality goals by leveraging clean hydrogen for enhanced reliability and resilience

Foster high-road jobs for energy workers and the possibilities available for a DOE-funded H2 Hub

Integrate clean hydrogen with electrification to create a clean energy system of complementary solutions

Demonstrate clean hydrogen microgrids in a community

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A Key Solution: Clean Hydrogen Microgrids*

Clean hydrogen microgrids enhance community energy resilience by leveraging distributed renewable energy production, storage, and use.

BENEFITS:

Local energy generation reduces strain and supports the electric grid.

Supply critical and emergency loads with zero greenhouse gas emissions during power outages

*Clean Hydrogen is defined as hydrogen produced with a carbon intensity equal to or less than two kilograms of carbon dioxide-equivalent produced at the site of production per kilogram of hydrogen produced and does not use any fossil fuel in its production process.

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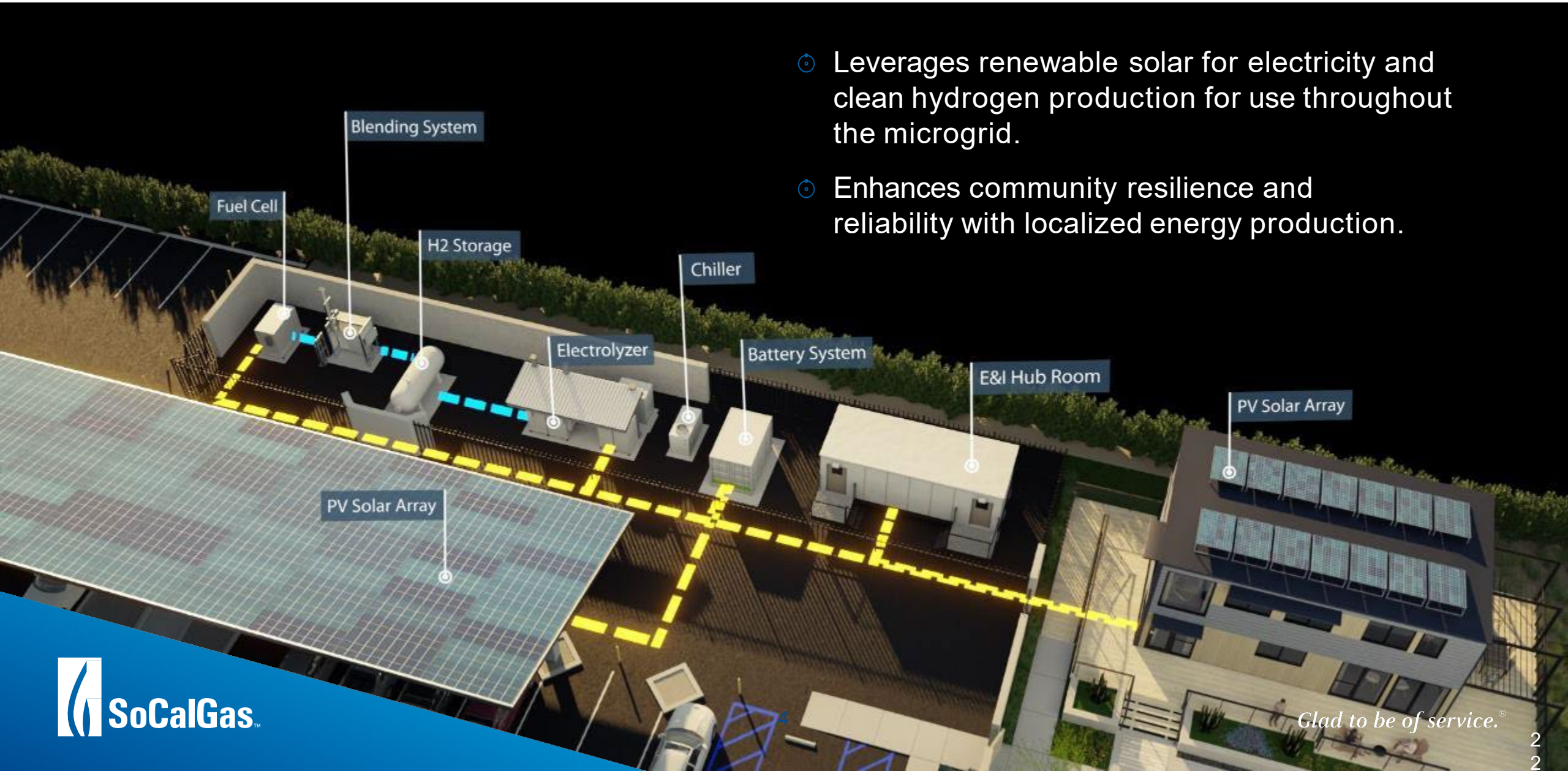
How [H2] Innovation Experience Works

- Leverages renewable solar for electricity and clean hydrogen production for use throughout the microgrid.
- Enhances community resilience and reliability with localized energy production.



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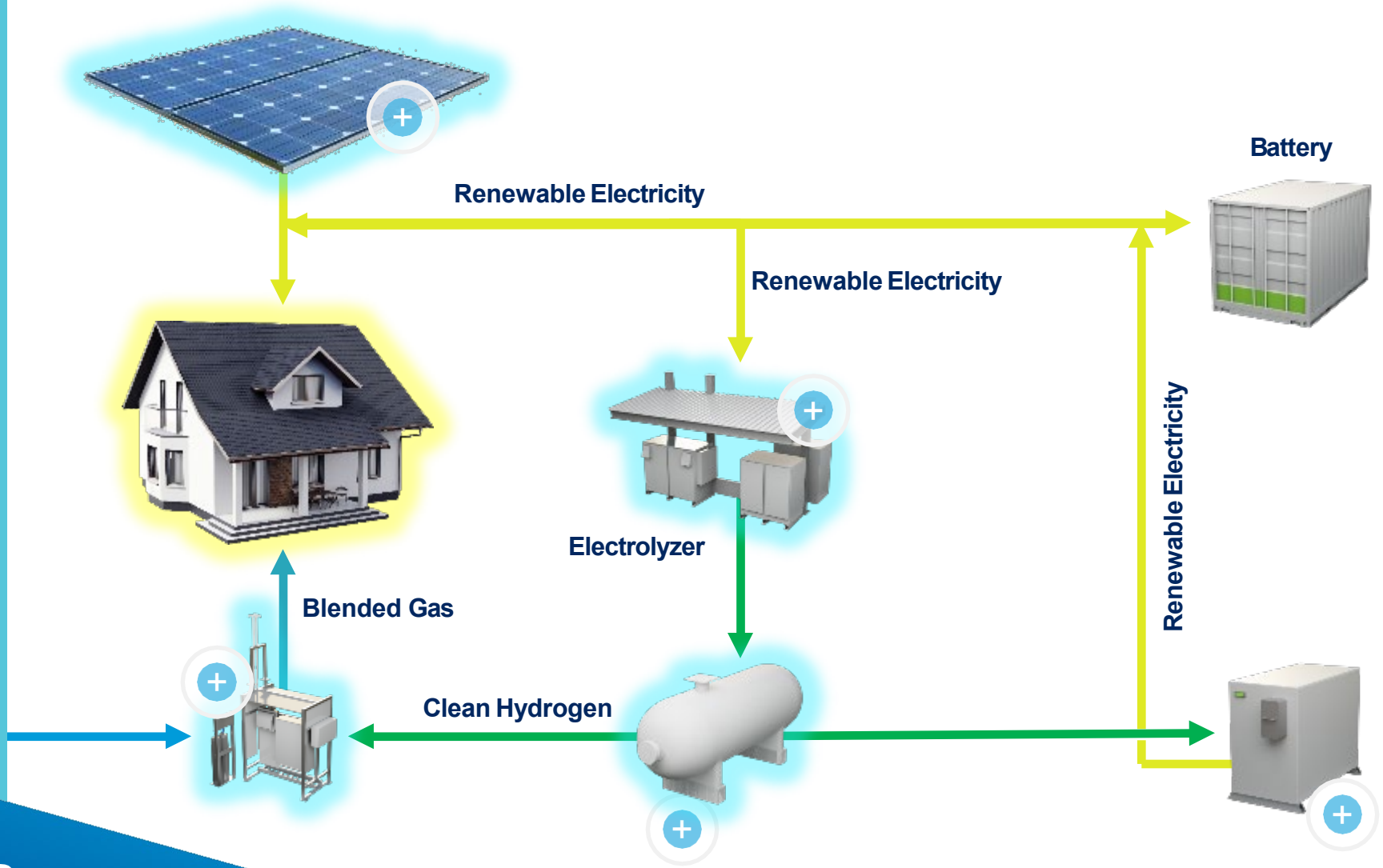
[H2] Innovation Experience

CAN POWER
OVER
100
HOMES



DAY

SOLAR
AS MAIN
POWER
SOURCE

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[H2] Innovation Experience Sustainability Goals

- Targeting LEED Platinum Certification

- High-Performance Green Building Design
- Sustainable Landscape
- Water Management System

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Benefits

Environmental

- Emissions reduction and air quality improvements.
- Use renewables to produce green hydrogen for community power and heating needs.

Scalability

- The [H2] Innovation Experience is scalable to serve neighborhoods or commercial buildings.
- Support clean hydrogen scaling and gas grid connection.

Resiliency & Reliability

- Support communities with 24/7/365 clean energy.
- Continued energy supply during power outages and Public Safety Power Shutoffs (PSPS).