Grid Modernization: Global Insights & Local Solutions

Wednesday, November 29 | 3:00-4:30 PM PT

LOCAL GOVERNMENT SUSTAINABLE ENERGY COALITION

CALIFORNIA CLIMATE & ENERGY COLLABORATIVE CCEC

lgsec.org | eecoordinator@civicwell.org

Local Government Sustainable Energy Coalition (LGSEC)

LOCAL GOVERNMENT SUSTAINABLE ENERGY COALITION

Mission

LGSEC advances local government leadership on clean energy and climate resilience through regulatory action, policies, and programs.

Vision

Local governments are a leading and innovative force in achieving energy and climate goals to create resilient and environmentally responsible communities across California.

Shape the Regulatory Agenda

Connect Local Energy Leaders

Catalyze Innovation

Develop Longterm Strategies

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California Climate & Energy Collaborative (CCEC)

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Moderator

Marc Costa

Director of Policy & Planning, The Energy Coalition | Co-Chair LGSEC

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Grid Modernization: Global Insights & Local Solutions

Purpose

This webinar will provide a dynamic discussion on the common challenges and potential solutions as governments from across the globe seek to transform the electric grid for a decarbonized future.

TODAY'S AGENDA

3:00 - 3:05	Welcome and Introductions
3:05 - 4:10	Speaker Presentations
4:10 - 4:25	Audience Q&A
4:25 - 4:30	Final Remarks
4:30 pm	Adjourn

Make sure to send your questions via the Q&A box!

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Speaker Introductions

Mark Paterson
Managing Director/Lead Systems Architect, Energy Catalyst Pty Ltd

Barry Hooper
Senior Green Building Coordinator, San Francisco Department of the Environment

Melanie Johnson
Electrical Engineering Researcher, US Army Engineer Research and Development Center Construction Engineering Research Laboratory

Stephen Honikman
Vice President of Business Development, Electriq Power

Speaker

Mark Paterson

Managing Director/Lead Systems Architect,
Energy Catalyst Pty Ltd

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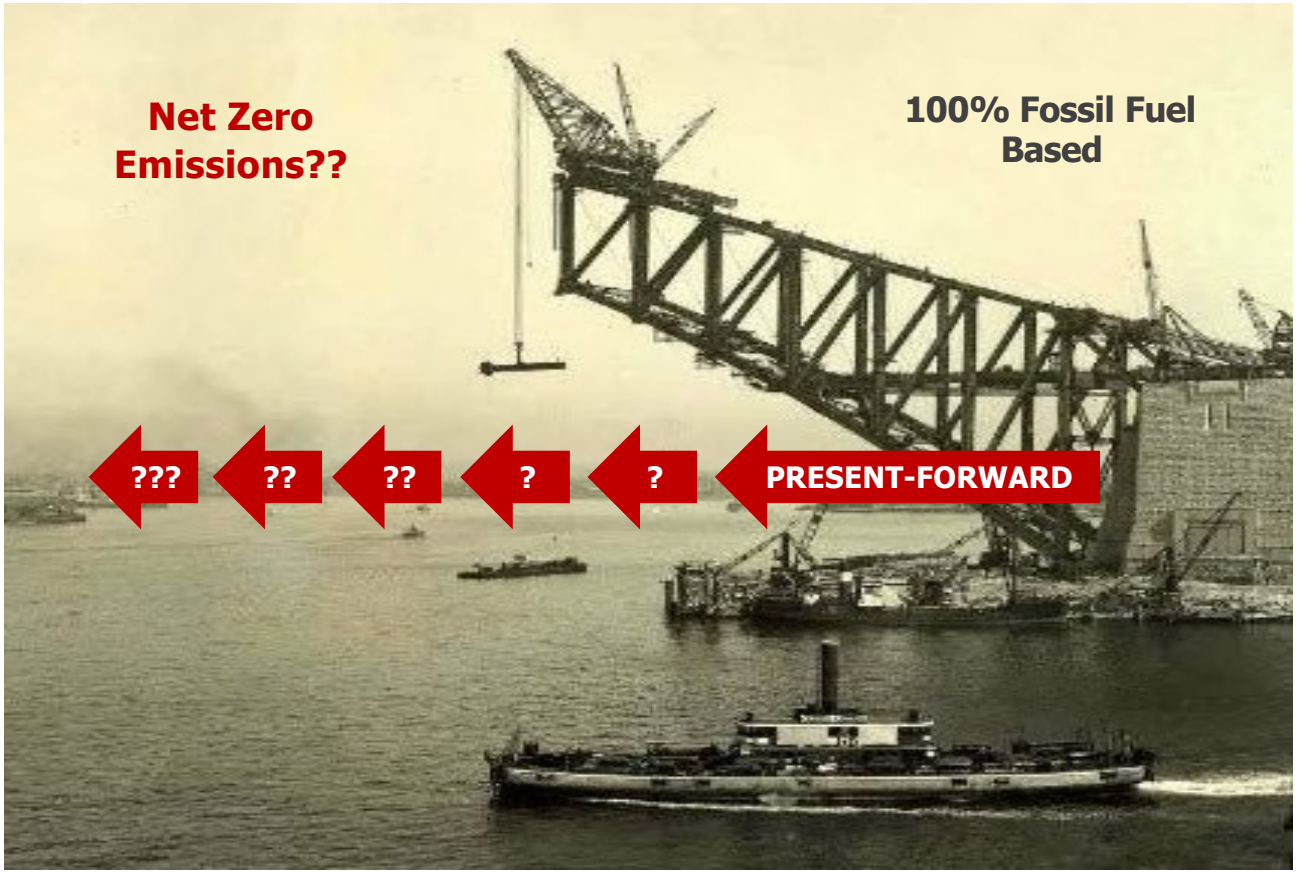
Grid Modernization:
Global Insight & Local Solutions

1. How might we think about changing a 100-year-old system?

How can Australia's grids transition to Net Zero Emissions?



How do Australia's grids safely navigate 'step change' transformation?

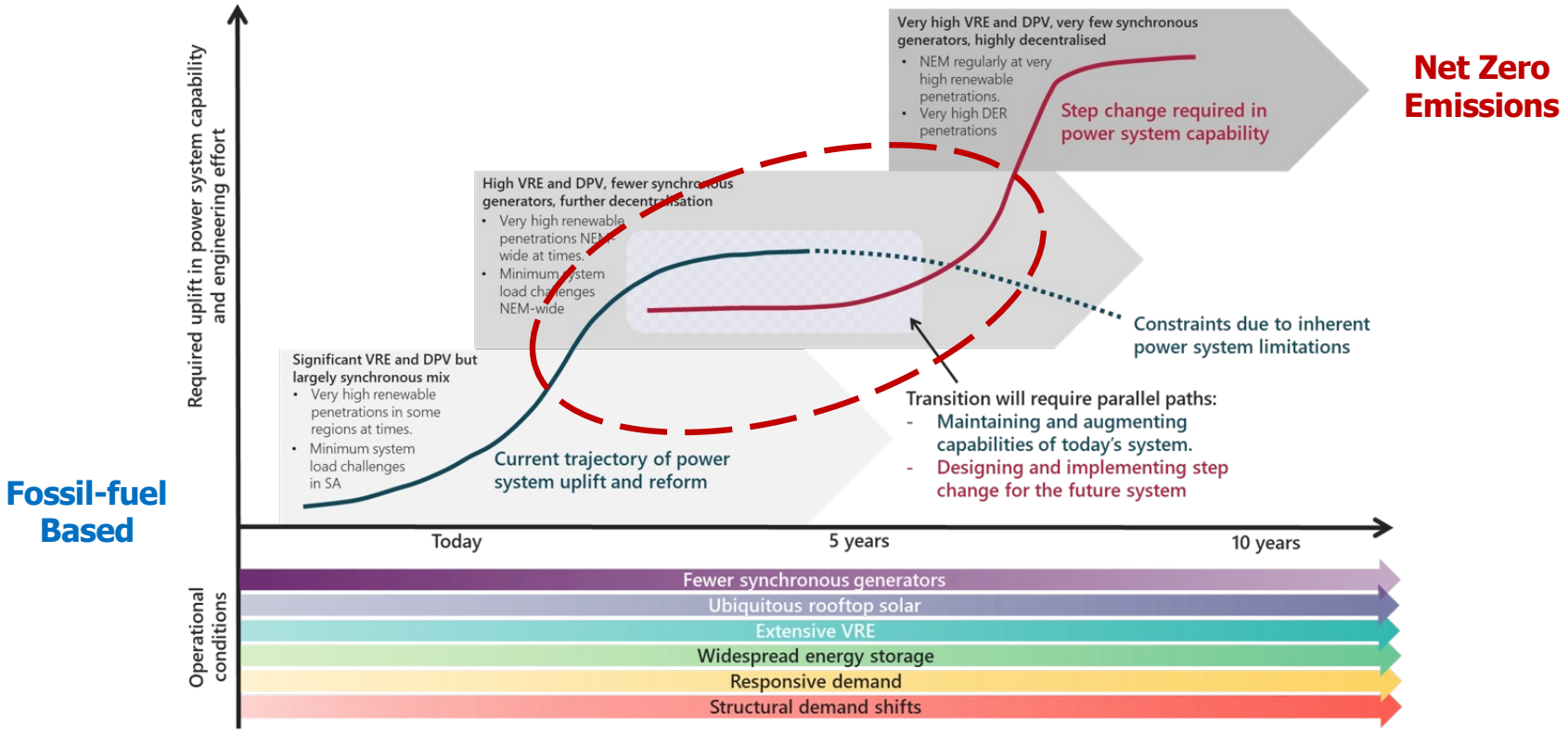
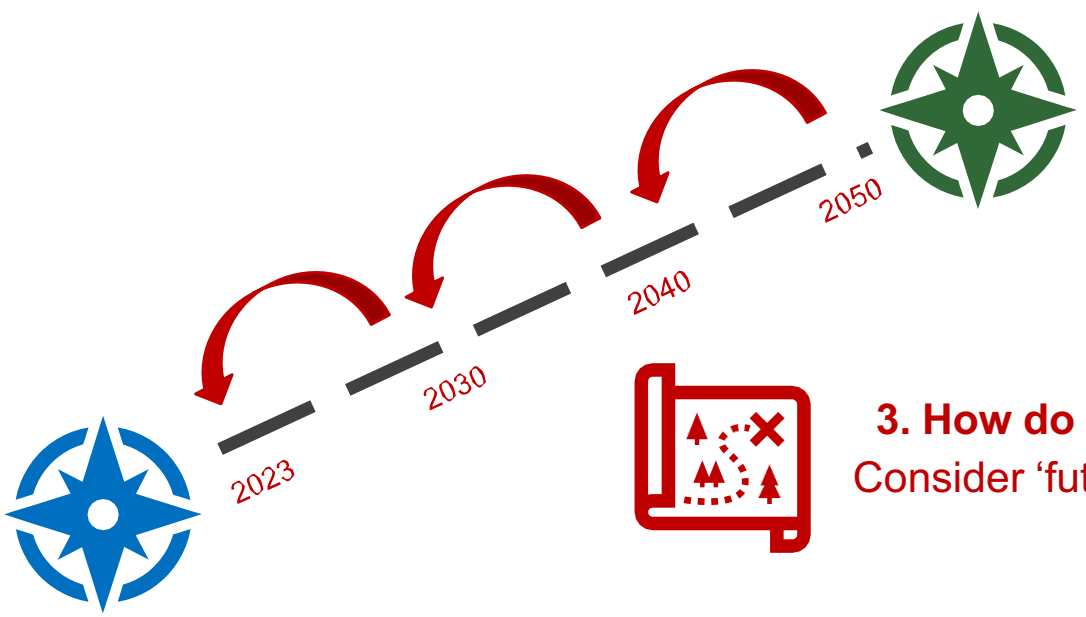


Image: Engineering Framework – Interim Roadmap, AEMO, 2021; adapted from A Gambit for Grid 2035 – A systemic look into the disruptive dynamics underway, Pacific Energy Institute, 2021

A simple way of thinking about transition design…

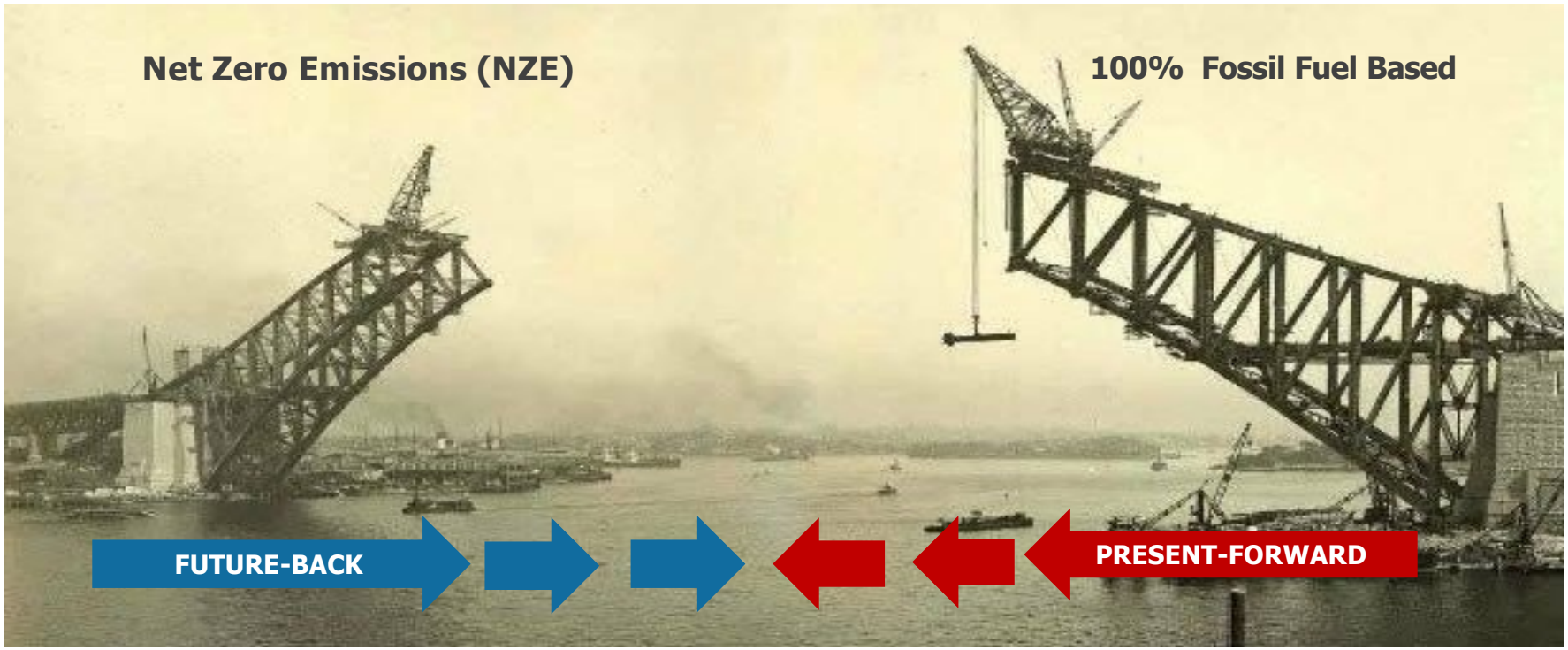


2. Where are you going?
Target future system

3. How do you get there?
Consider ‘future-back’ design

1. Where are you now?
‘As built’ power system

Systems Architecture-based tools enable transition design from both the 'present-forward' and 'future-back' perspectives

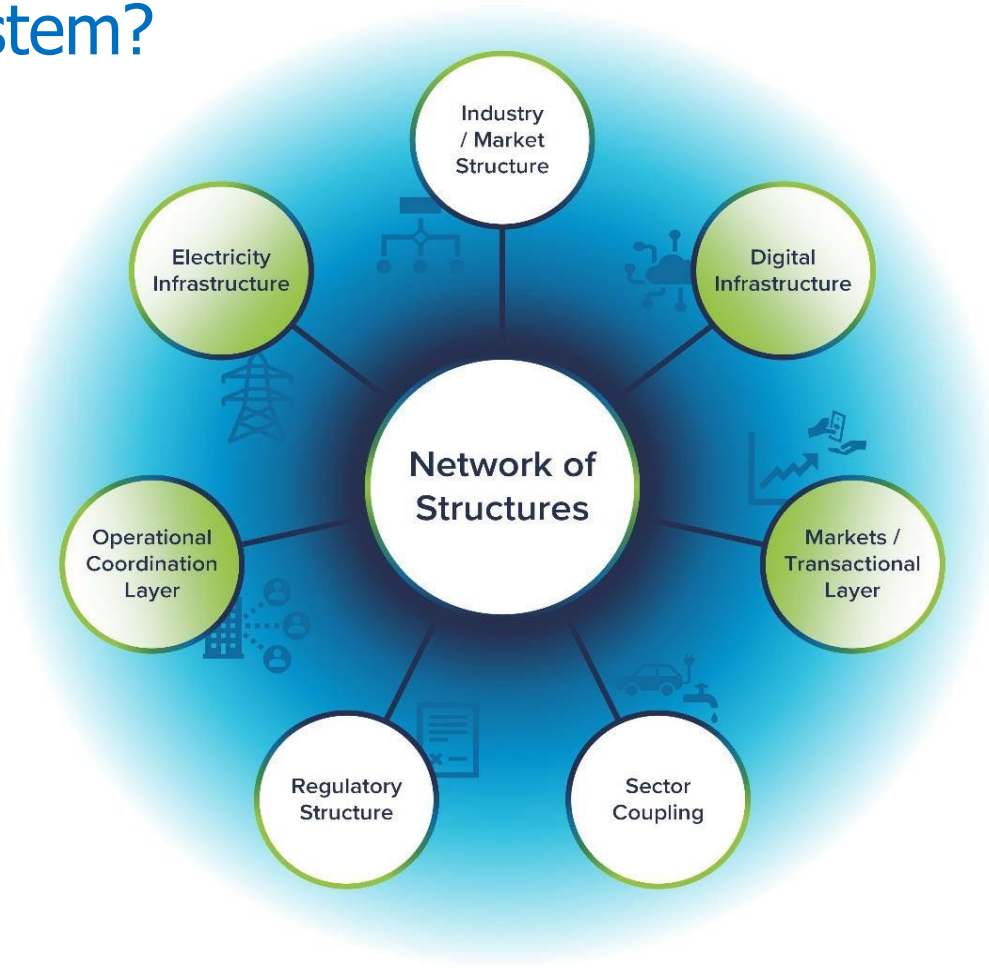


2. Understanding our Existing Power Systems

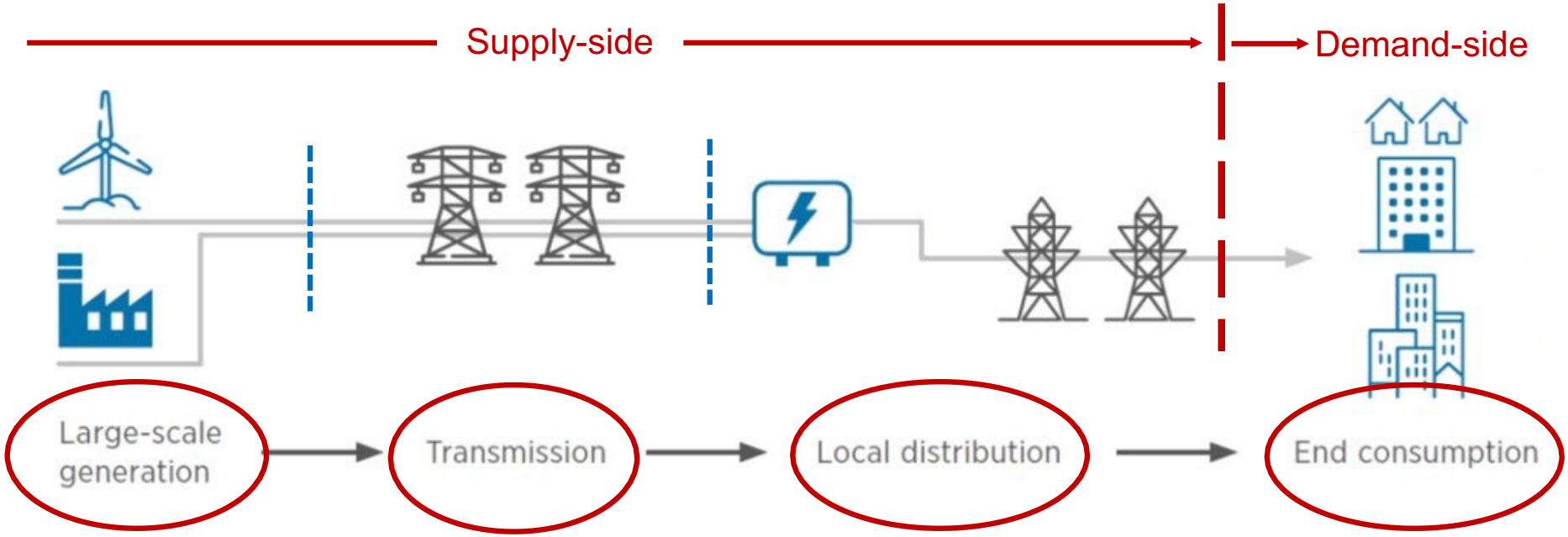
What is a GW-scale power system?

A modern Power System is an ultra-complex web of **seven structures**, four of which are functionally interdependent:

1. Electricity Infrastructure (Power Flows);
2. Digital Infrastructure (Information/Data Exchange);
3. Operational Coordination Structure;
4. Transactional Structure;
5. Industry / Market Structure;
6. Regulatory Structure; and,
7. Sector Coupling Structures (Gas, Water, Transport, etc).



The power systems we inherited…

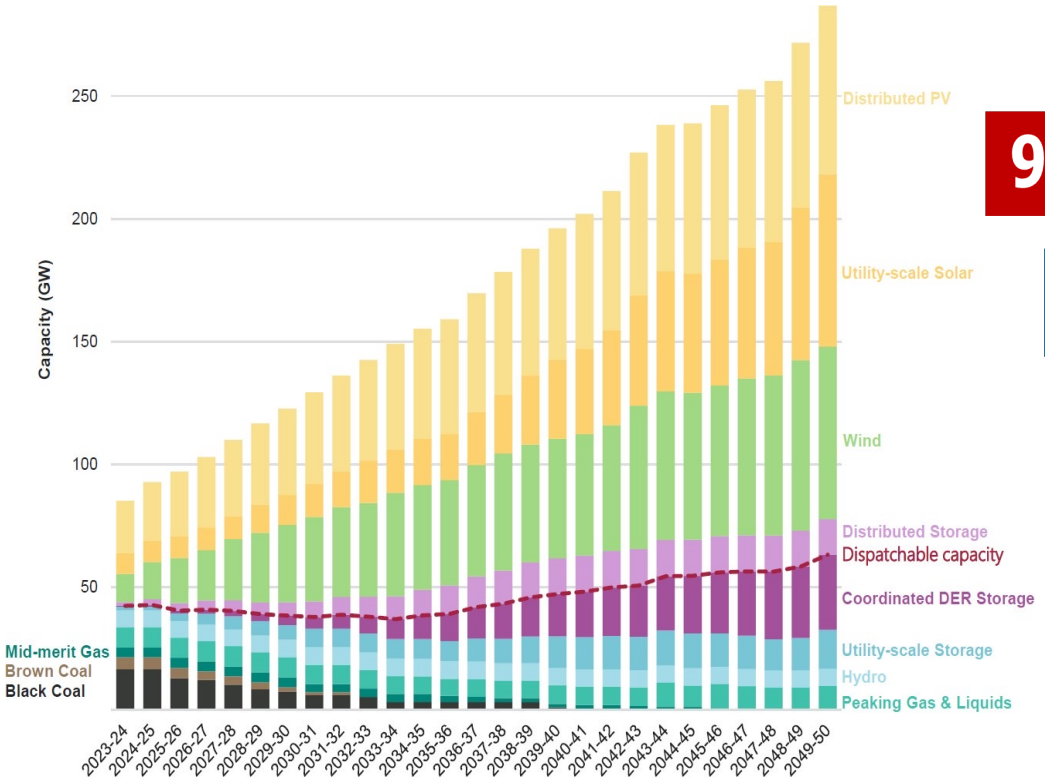


A one-directional bulk delivery system made up of distinct functional siloes

Image: IRENA System Operation Collection (2020)

3. How are our Power Systems Changing?

Australia's power systems are changing dramatically



AEMO 'Step Change' scenario

9x Utility Wind & Solar VRE

5x Distributed Solar PV

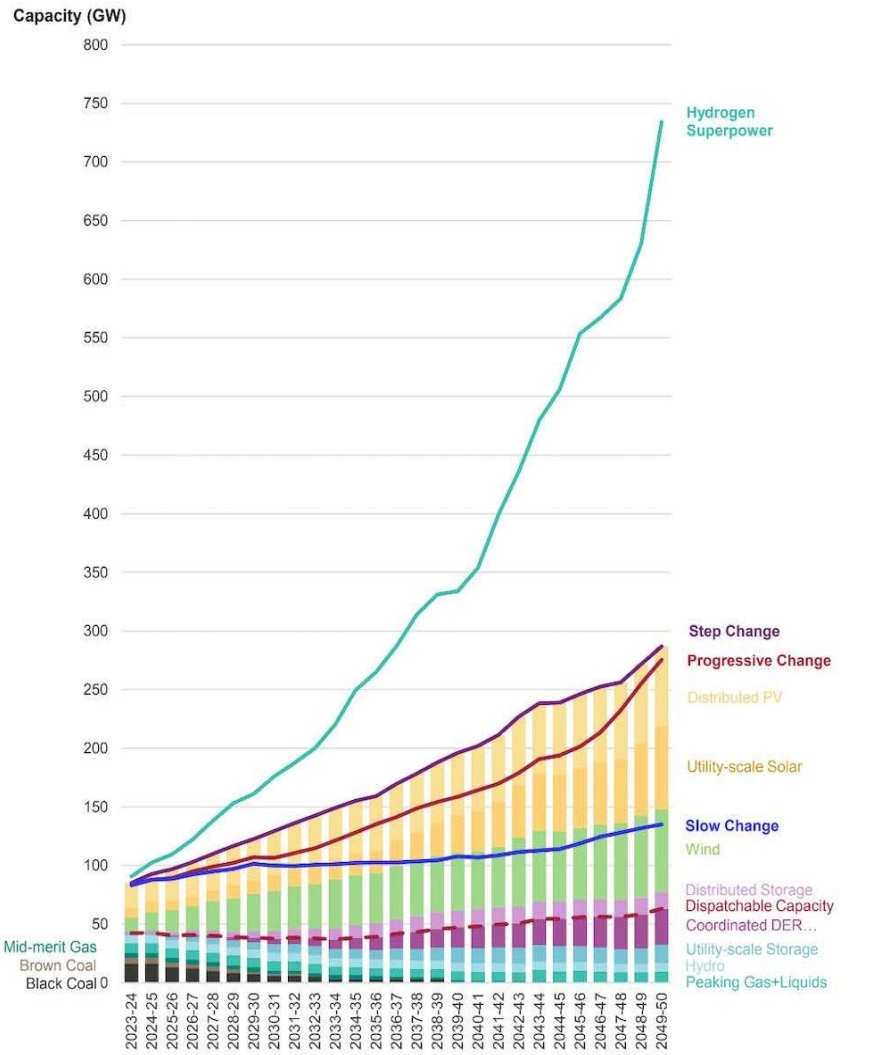
3x Dispatchable Firming Capacity

99% Electrification of Transport

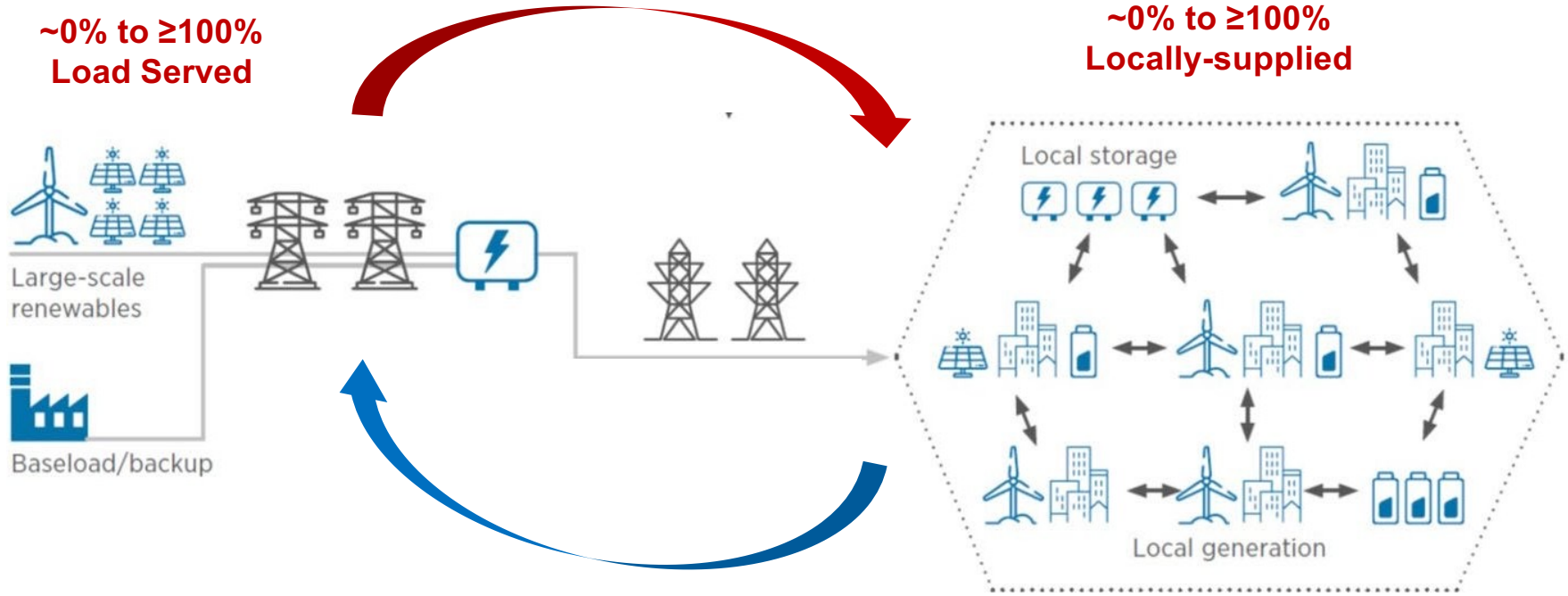
AEMO 'Hydrogen Superpower' scenario

>20x

Utility-scale VRE



The power system that is fast emerging…



A power system that requires an entirely new level of **dynamic, whole-system** inter-dependence

Image: IRENA System Operation Collection (2020)

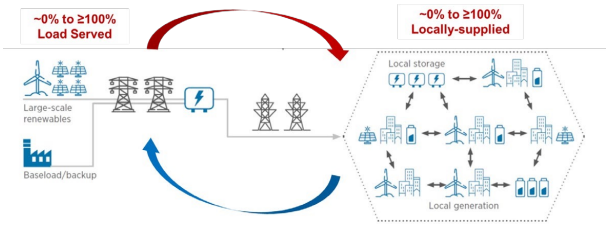
Customer & Societal Objectives for future power systems

Eight major objectives identified:

1. **Dependable**: Safe, secure, adequate, reliable and resilient
2. **Affordable:** Efficient and cost-effective
3. **Sustainable:** Enables 2030 and 2050 decarbonisation goals
4. **Equitable:** broad accessibility of benefits and the fair sharing of costs
5. **Empowering:** Advances customer and community agency, optionality, and customisation
6. **Expandable:** Enables electrification of transport, building services and industrial processes
7. **Adaptable:** Flexible and adaptive to change, including technological, regulatory and business model innovation
8. **Beneficial:** Socially trusted, public good/benefits, commercially investable and financeable

4. What are the Opportunities for Local / Modular Energy Solutions?

What core problem are we solving...?



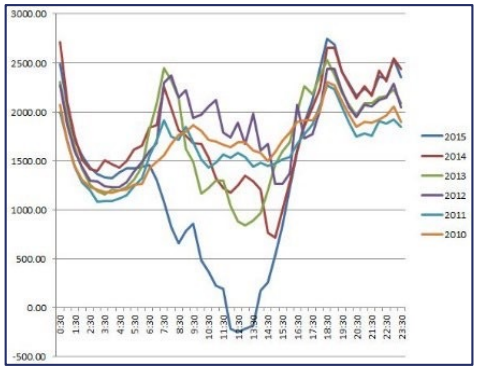
As our 20th century power systems are decarbonised, these ultra complex physics-based systems face increasing volatility at levels unforeseen by their original architects. Compounded by the accelerating withdrawal of traditional sources of system flexibility* this is a context where…

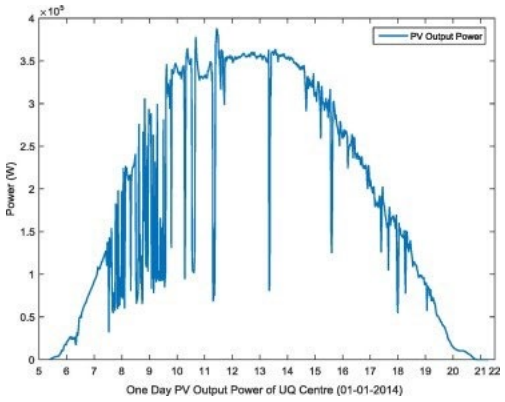
> *Bulk power, transmission and distribution systems – and the rapidly expanding fleet of distributed resources – must function far more **dynamically and holistically** end-to-end to enable a secure, cost-efficient and self-balancing future power system.*

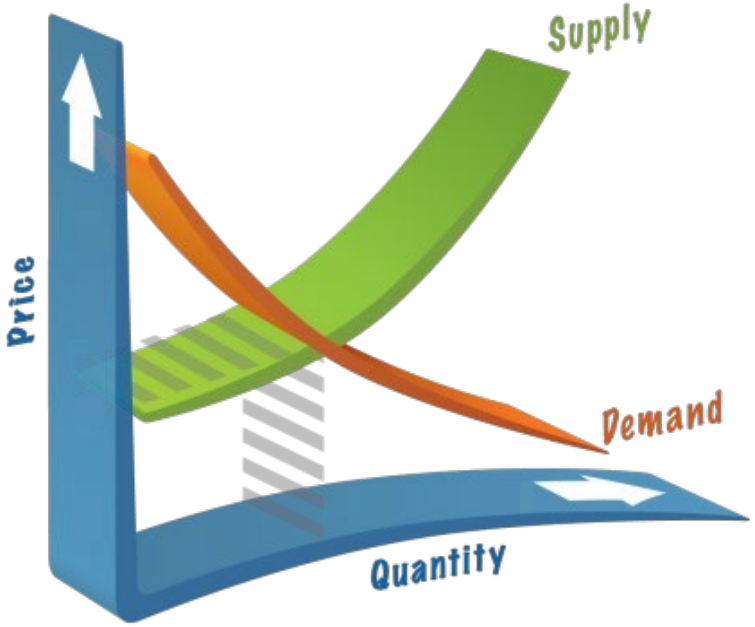
Digitalisation, interoperability, dynamic firming, transport electrification, enhanced asset utilisation and DSO models will all have a role to play. What is often poorly understood, however, is that all these solutions, and many others, cannot reach their full potential without an integrated approach to ensuring the underpinning structural relationships (or 'architecture') of the [illegible] are future-ready.

* Dispatchable coal-fired generation been a dominant source of system flexibility for operating the NEM.

EXHIBIT A: Decarbonising power systems are becoming increasingly volatile but still require instantaneous balancing of demand and supply







Customer demand and variable generation must still be kept ‘in balance’ every microsecond of the year as the dispatchable generation fleet is withdrawn

EXHIBIT B: The Operational Coordination of hundreds of dispatchable, merchant energy resources was (comparatively) simple

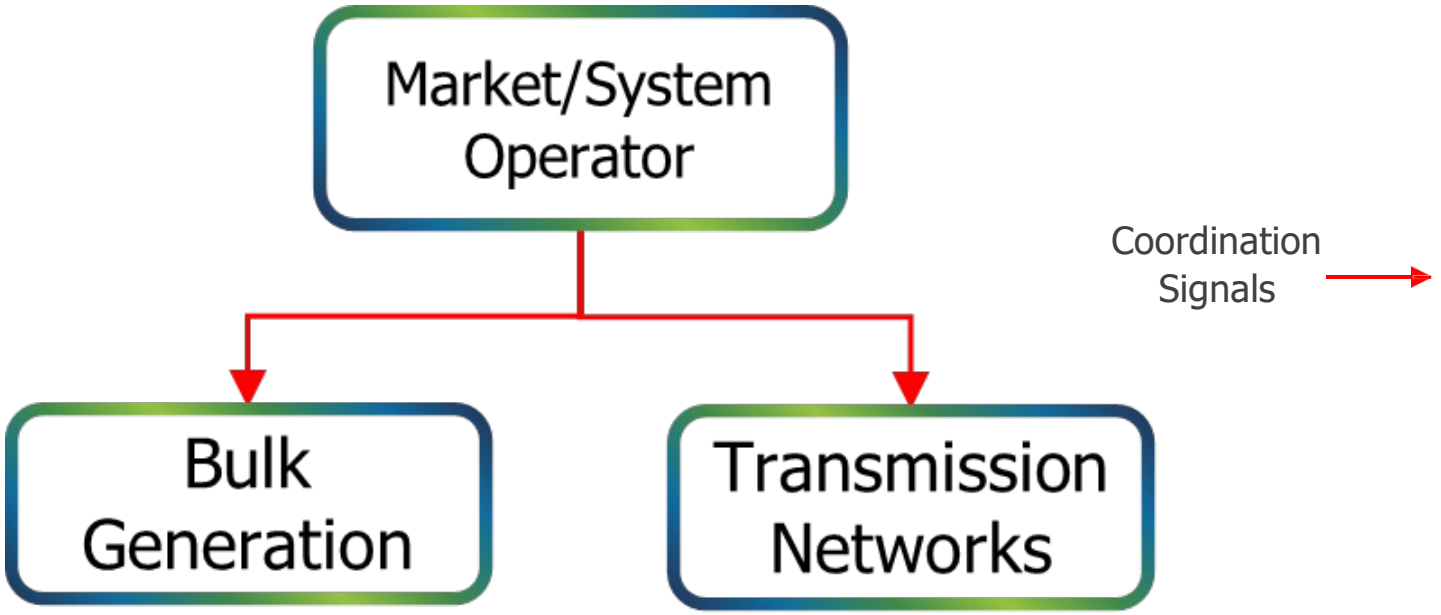
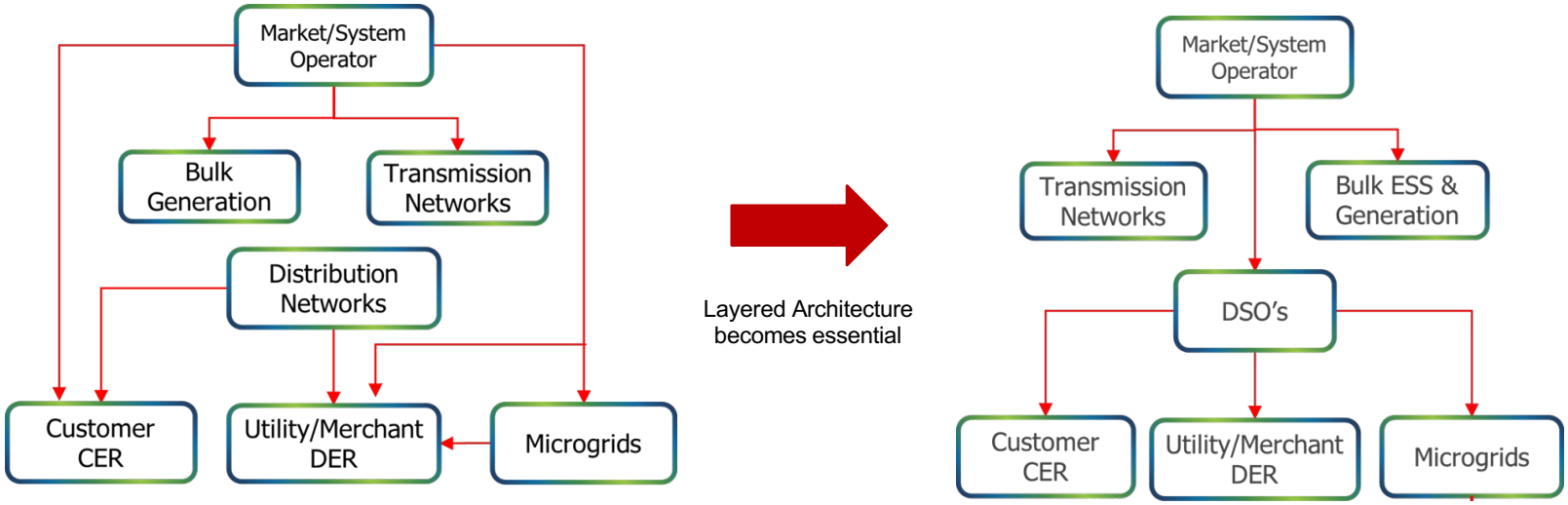


EXHIBIT B: New structures become essential for the Operational Coordination of tens of millions of diverse and dynamic participating energy resources



20th Century Grid Evolved

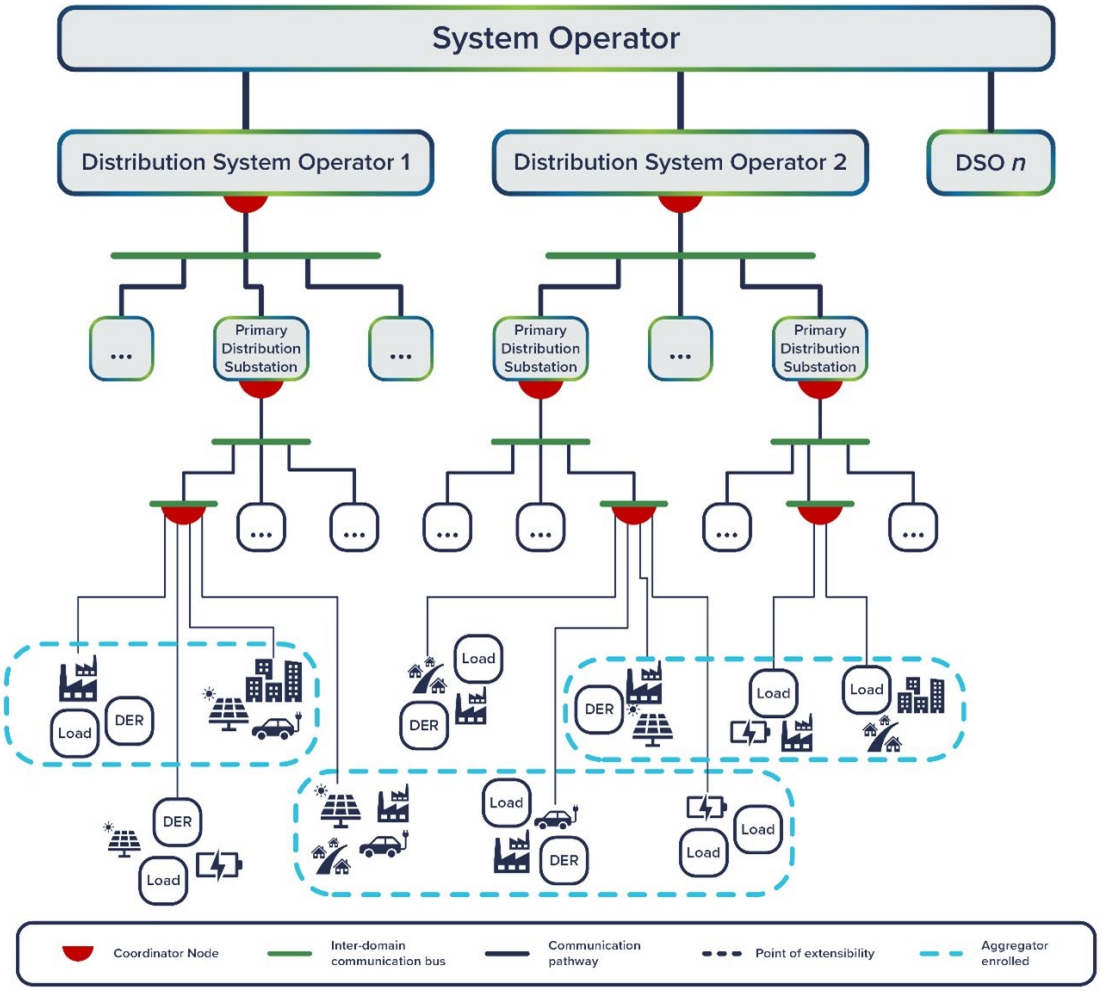
Increasing scalability, operational coordination and latency cascading issues

21st Century Grid Transformed

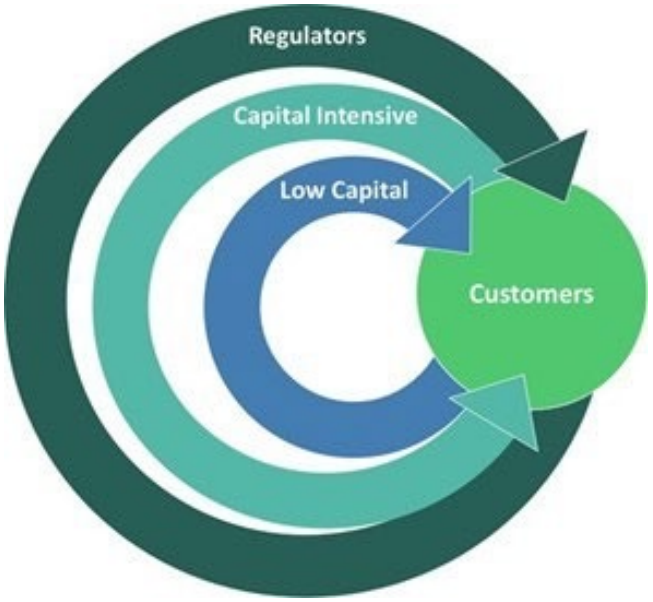
Secure, scalable, resilient, flexible, cost-effective and human-centred

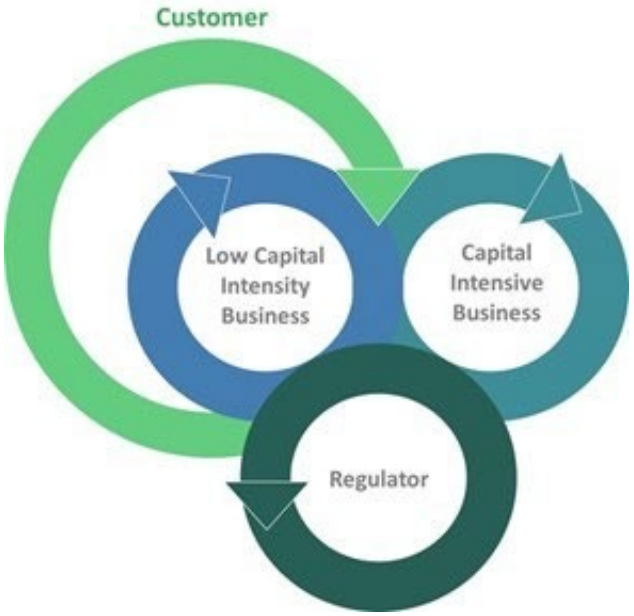
Over time, a complex range of new Operational Coordination relationships have evolved as an entirely new class of LV-connected energy resources have emerged at massive scale

The Layered Architectures key to enabling a deeply decarbonized grid intrinsically support a far more modular approach involving microgrids and DERs



All of this requires the most fundamental transformation of all…

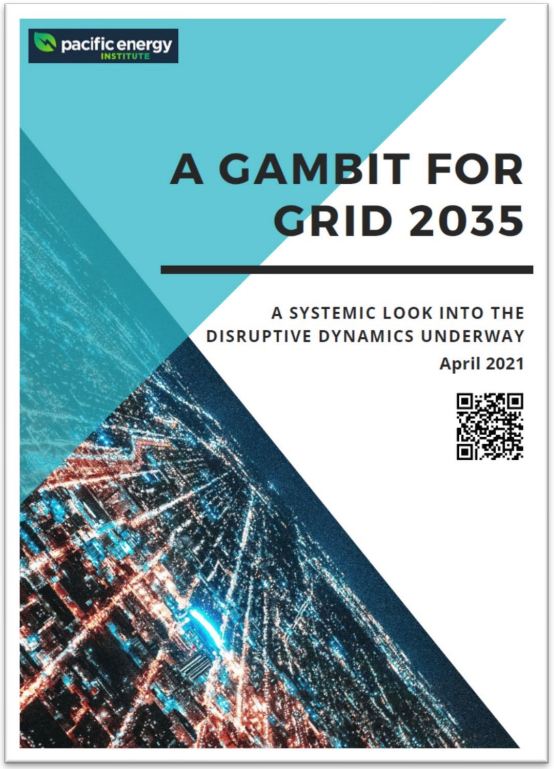


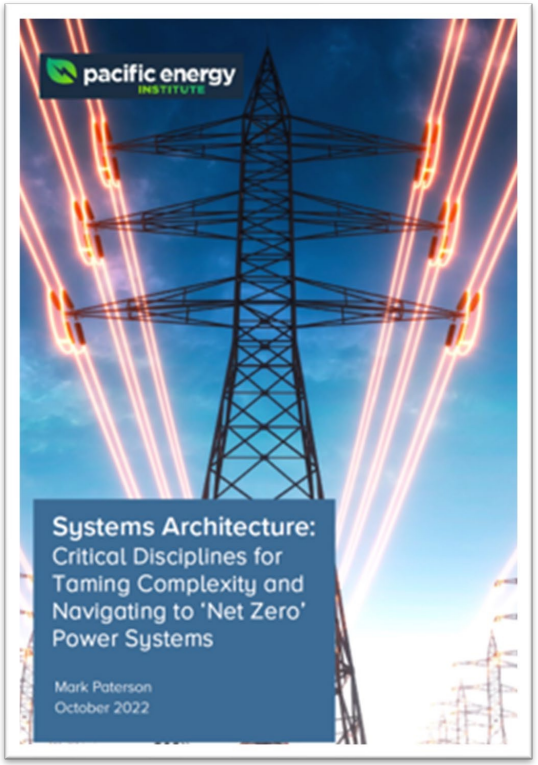


20th Century
Grid-centric Regulation

21st Century
Customer-centric Regulation

Further Reading





All white papers are hyperlinked

Questions & Discussion

Please contact Mark Paterson: mpaterson@energycatalyst.au

MARK PATERSON

Principal

Lead Systems Architect

Energy Catalyst

With over two decades in the energy sector, Mark's theoretically robust but pragmatic approach is grounded in applied technology origins and Engineering, Business and Master of Enterprise qualifications. Working at the intersection of strategic vision and practical application, Mark has led several national energy system transformation projects, including as Chair of the CSIRO Future Grid Forum and Program Director of the CSIRO/ENA Electricity Network Transformation Roadmap. At Horizon Power and Energex, two Australian energy utilities serving remote, regional and metropolitan customers, he led the innovative development and scale deployment of several utility technology innovation firsts.

Over much of the last decade, Mark has been privileged to develop leading expertise in Power Systems Architecture disciplines which are now increasingly recognised as critical for enabling the deep decarbonisation of legacy power systems. He is formally trained in both the Systems Architecture and Grid Architecture methodologies developed respectively by the Massachusetts Institute of Technology (MIT) and the US Department of Energy's Grid Modernisation Laboratory Consortia (GMLC). Focused on future-informed action, this expertise is further complemented by Strategic Foresight and Technology Roadmapping methodologies developed by EDHEC in Europe and Cambridge University in the UK.

Internationally, Mark is a Fellow of the Pacific Energy Institute and an Associate of the US Department of Energy's GridWise Architecture Council (GWAC). He is also a contributing author for the IEEE Power & Energy and an invited expert contributor to Asia-Pacific Economic Cooperation (APEC) grid resilience activities.

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Speaker

Barry Hooper

Senior Green Building Coordinator, San Francisco Department of the Environment

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Photo: Creative Commons via MS Bing

Is the grid ready for all-electric business districts?

Barry Hooper

November 29, 2023

SAN FRANCISCO ENVIRONMENT DEPARTMENT

Agenda

- Problem
- Resources
- Findings

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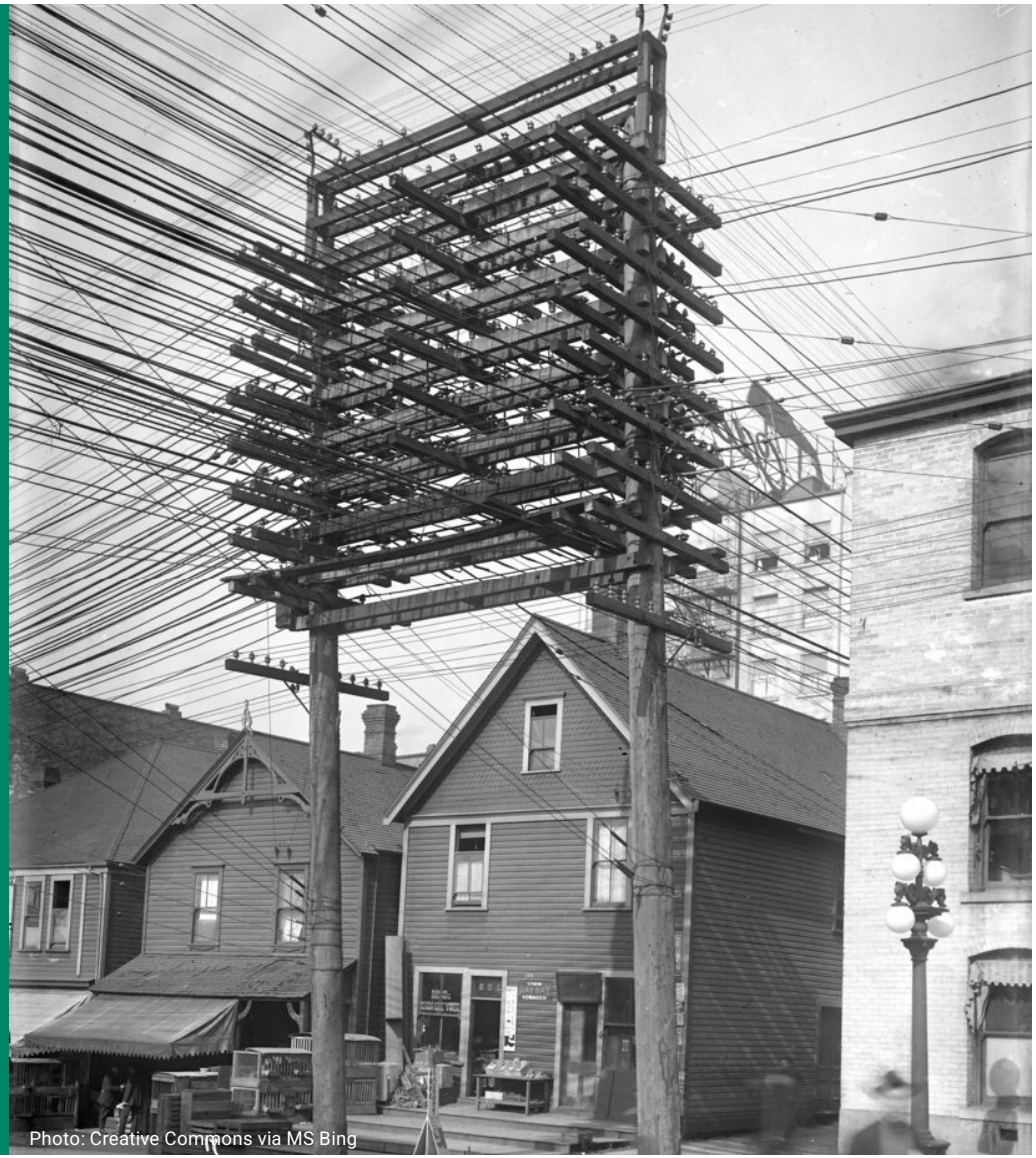

San Francisco Zero Emission Buildings Task Force

The cost of failing to act on climate risk is great.

The City and constituents have shared interest in climate risk mitigation

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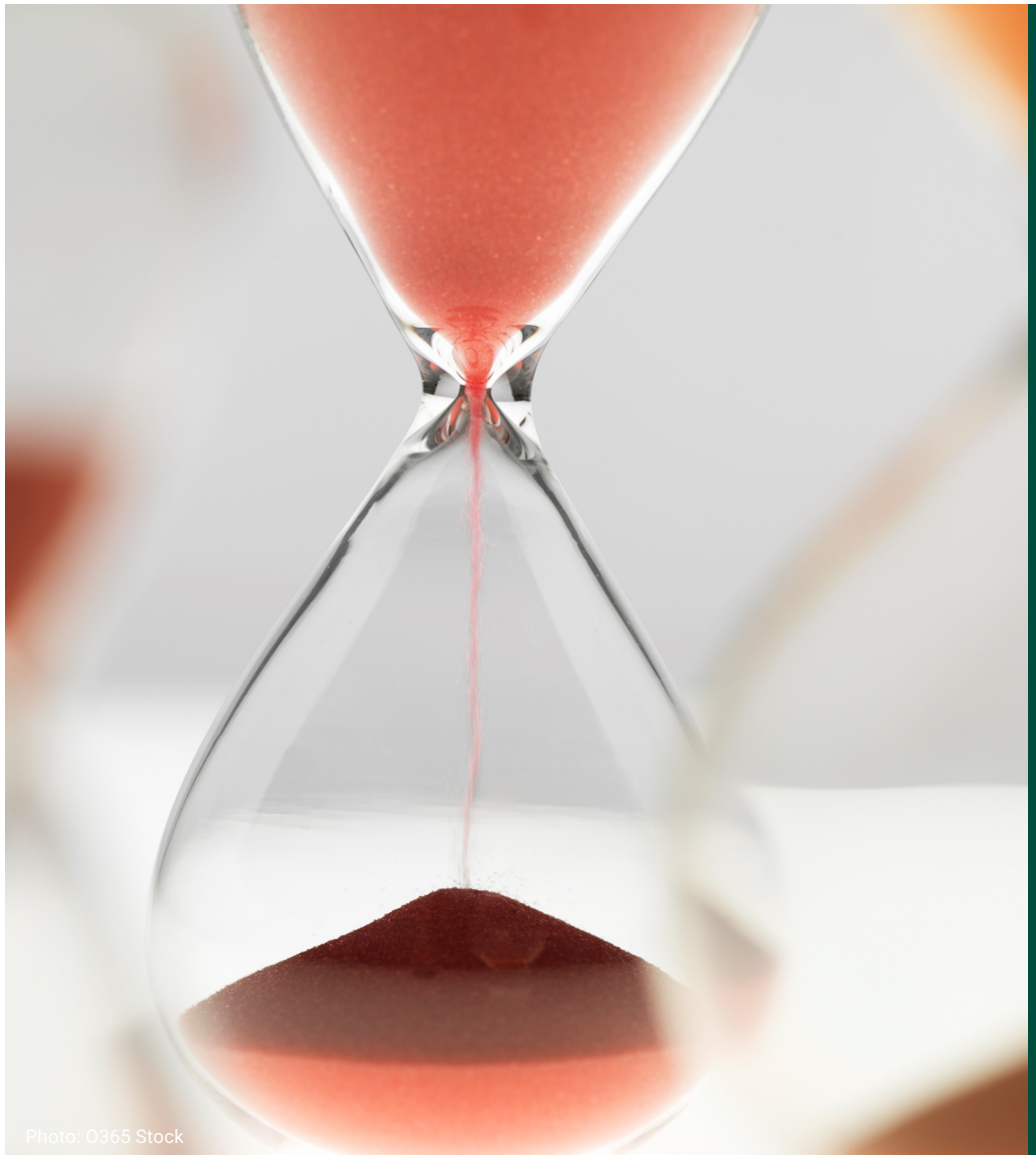

Climate Action Goals

2030
Reduce emissions 61%

2035
Large existing commercial:
zero emissions

2040
Net zero emissions citywide

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Can the grid accommodate electrification?

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Roles

Building owner
Electrify the building

Utility
Serve customers
Safe infrastructure

City
Economy
Public safety

Lawrence Berkeley Lab (LBNL)
Innovate and inform

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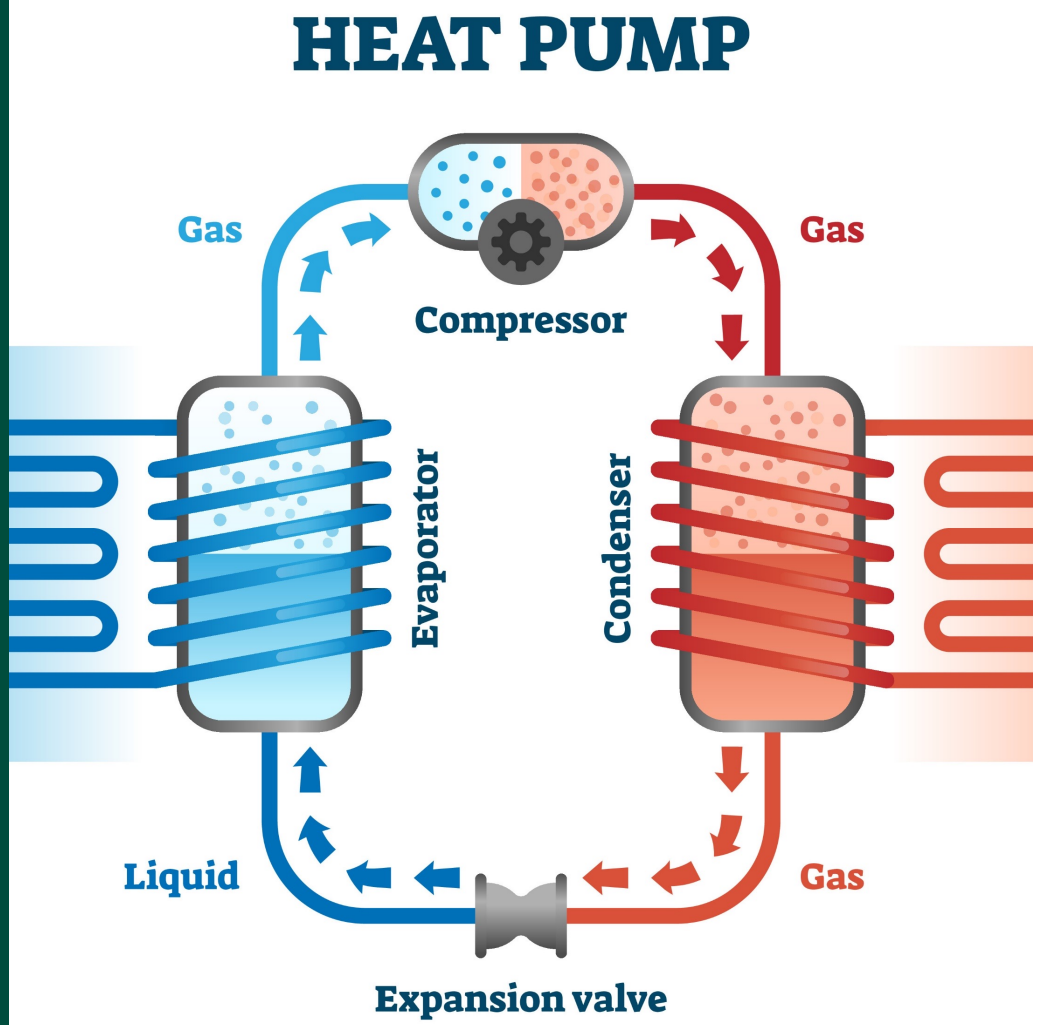

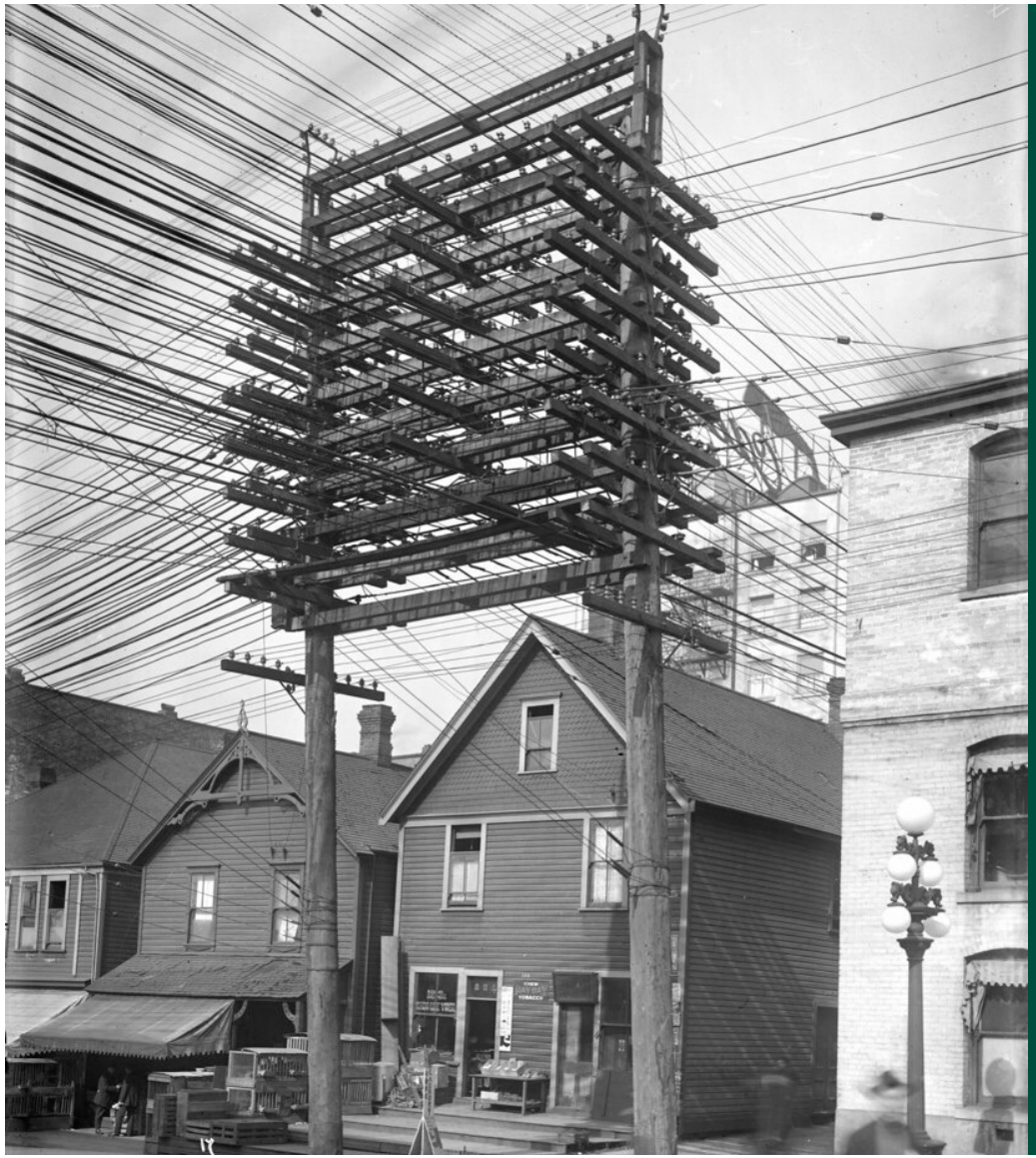

Grid infrastructure improvements

- Require time
- Capital intensive
- Complex
- *Local government knowledge?*
  - New development: Yes
  - Existing buildings: ?

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Public records: Utility

In California, data about the grid and customers is confidential.

Exceptions:

- Integration Capacity Analysis (ICA) for Distributed Energy Resources
- Energy benchmarking

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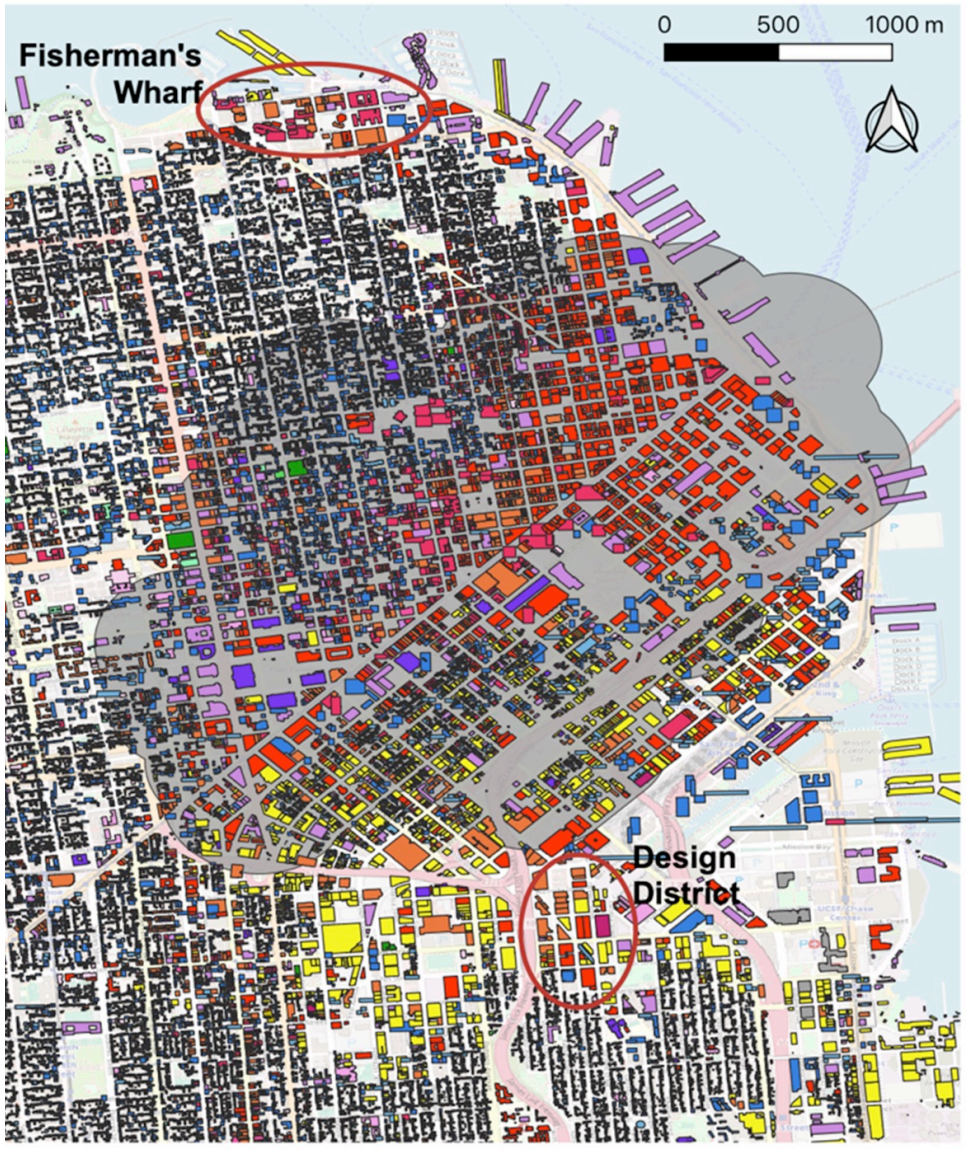

Public records: City

Government

- Land use
- Code vintage and equipment
- Energy use

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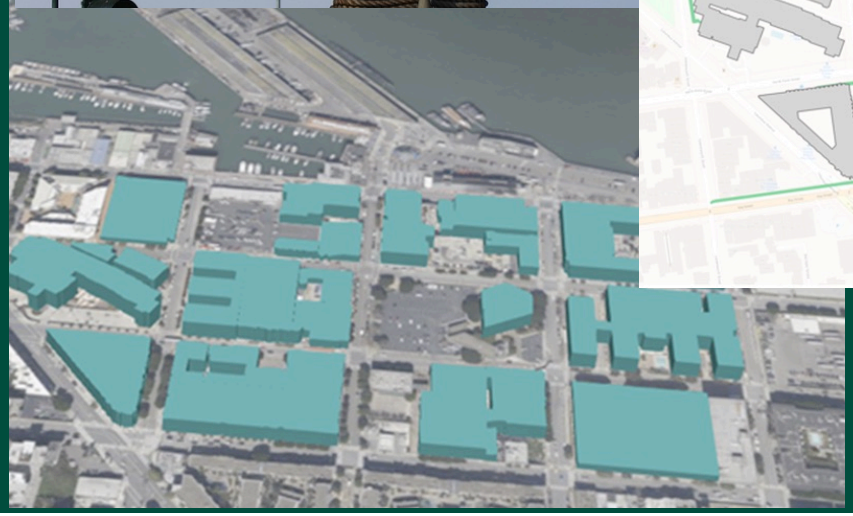
Quantify impact of electrifying all buildings in a business district



(and repeat for another district)

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LBNL Analysis

1) Calculate 10-minute load profile for each building

   Calibrate baseline (today's electric grid)

   Add electrification and energy efficiency

2) Aggregate to district

3) Is peak demand greater or less?

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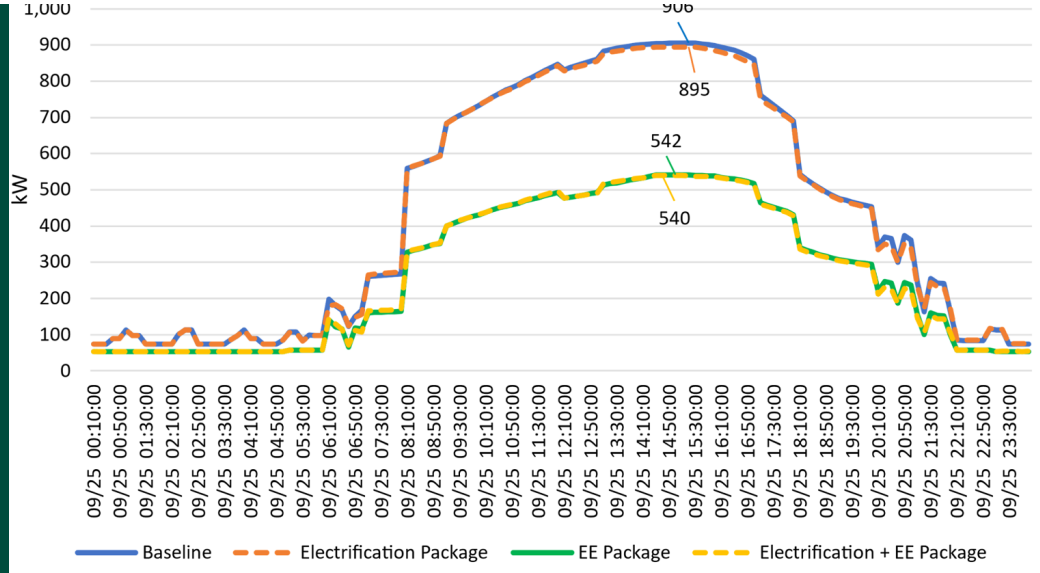
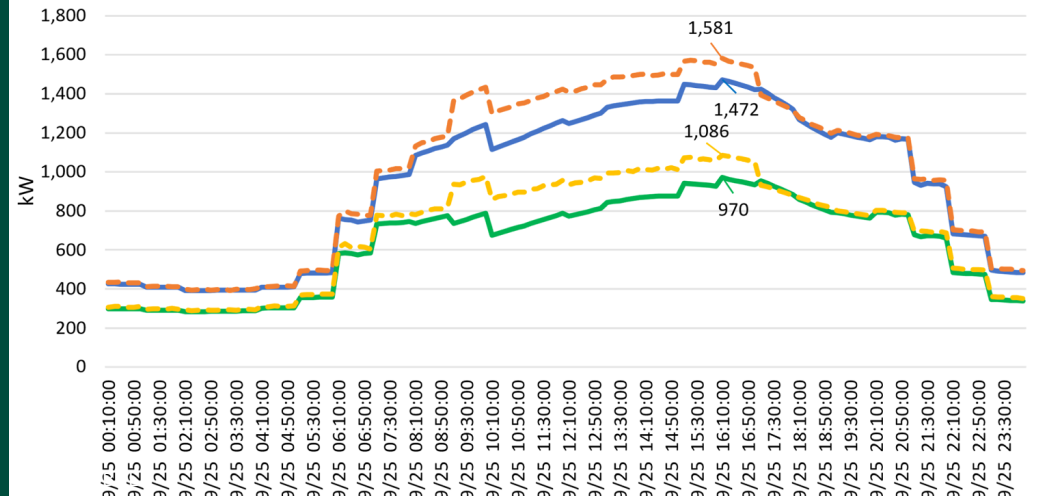
More info: Hong T, et al (2023) Nexus of Electrification and Energy Efficiency Retrofit of Commercial Buildings at the District Scale, Sustainable Cities and Society Vol 95. https://doi.org/10.1016/j.scs.2023.104608



Fisherman's Wharf 10-minute Interval Power Profile on Peak Demand Day



Scenario	Measure	Small hotel	Small office	Medium office
Electrification package	Replace existing HVAC with PTHP	X		
	Replace existing HVAC with ASHP		X	X
	Replace existing central gas boiler for space heating with an air-to-water heat pump			
	Replace gas water boiler with HPWH	X	X	X
	Replace gas cooking system with induction cooking system			
	Replace gas laundry system with electric system	X		
Energy efficiency package	Retrofit lighting with LED	X	X	X
	Add daylight controls	X	X	X
	Add occupancy sensors for lighting control	X	X	X
	Add roof insulation	X	X	X
	Install low-flow faucets and showerheads	X	X	X
	Install plug-load controls		X	X
	Enable demand controlled ventilation		X	X
	Add or repair economizer	X	X	X
	Add air sealing to reduce infiltration through envelope	X	X	X
	Add energy recovery ventilation unit		X	X

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Electrification and efficiency measures (normal stuff)

Scenarios

Baseline (today's electric grid)

Electrification (~T24)

Efficiency only

Efficiency and electrification

Updating equipment improves efficiency

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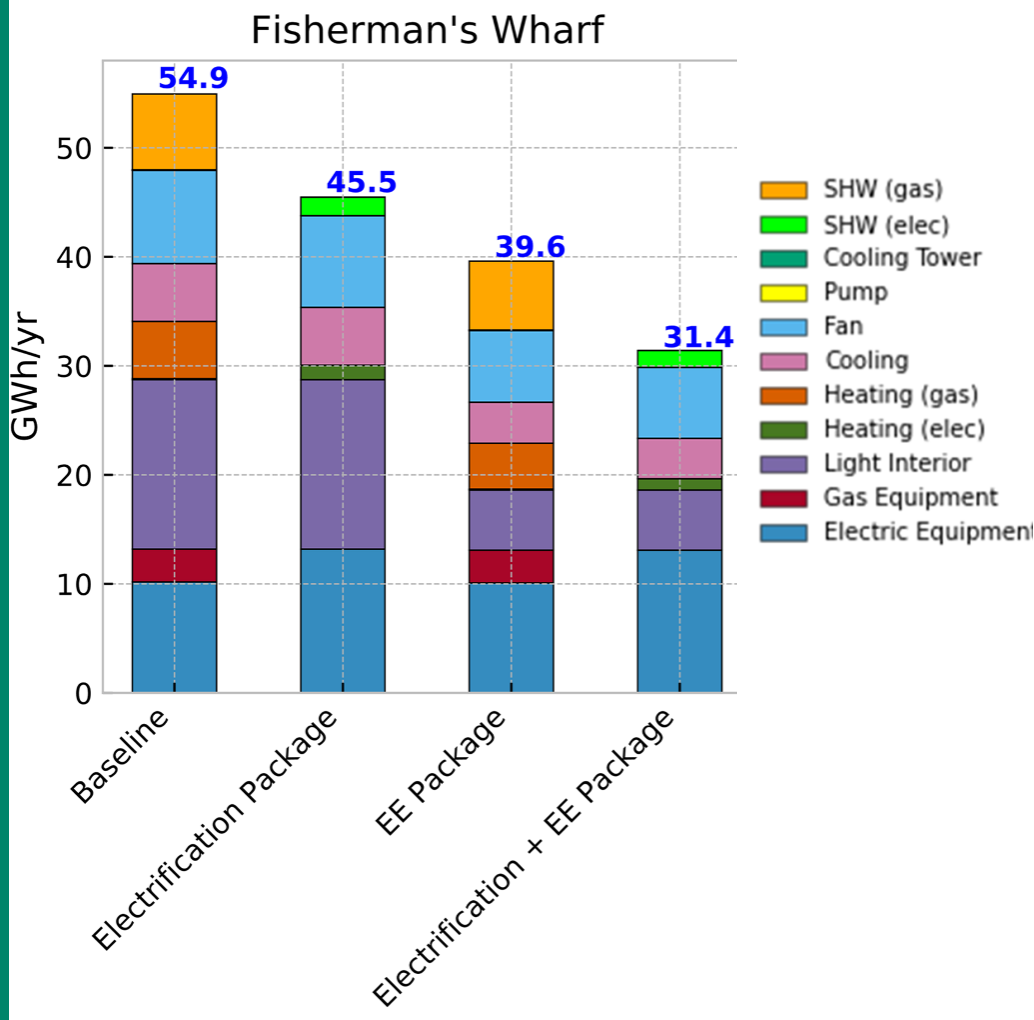

Scenarios

Baseline (today's electric grid)

Electrification (~T24)

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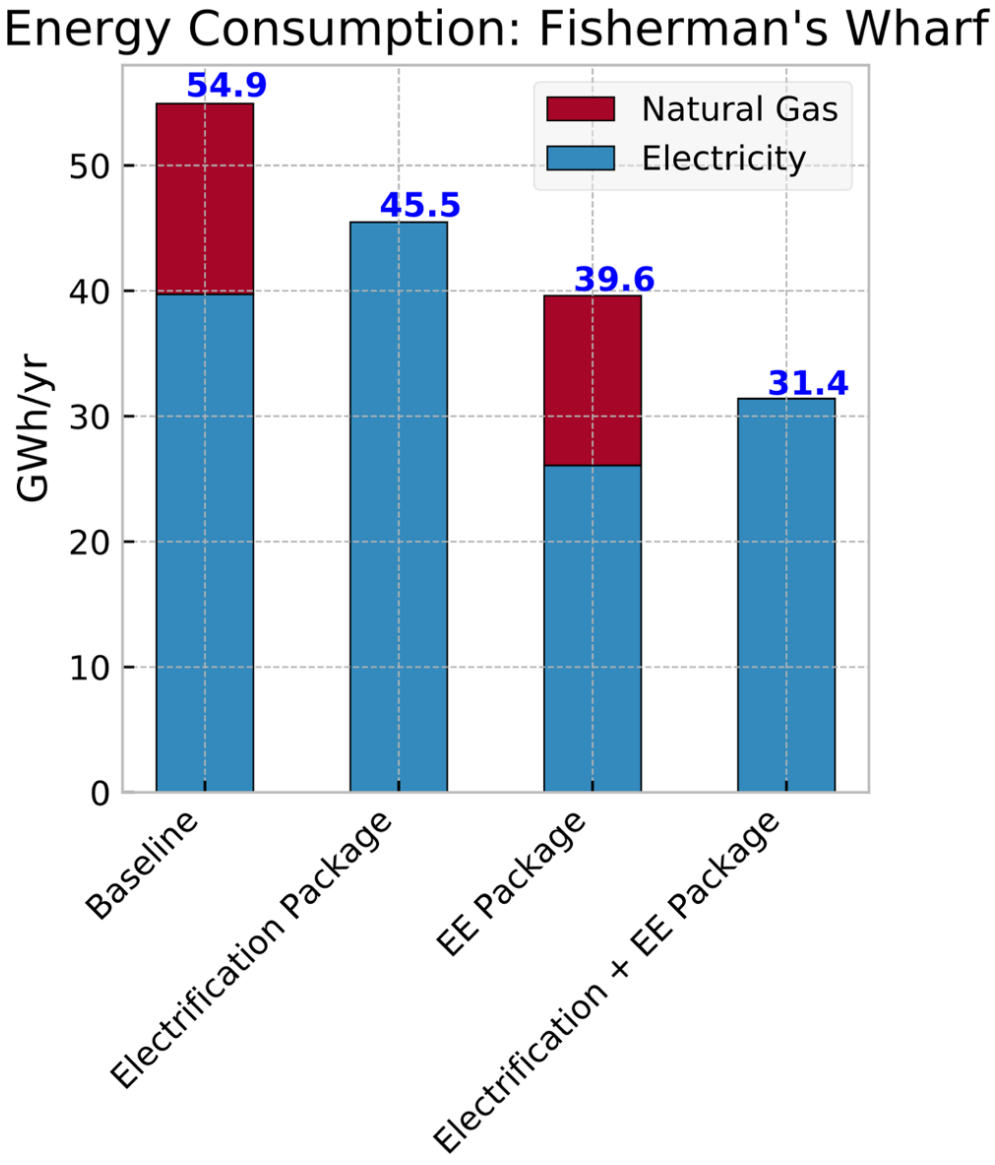

Results

Electrification only

- Wharf: Peak demand increased 7%
- Design District: Peak decreased 1%

Efficiency and electrification

- Wharf: Reduced peak demand 26%
- Design District: Reduced peak 40%

*All results were within capacity of today's grid **

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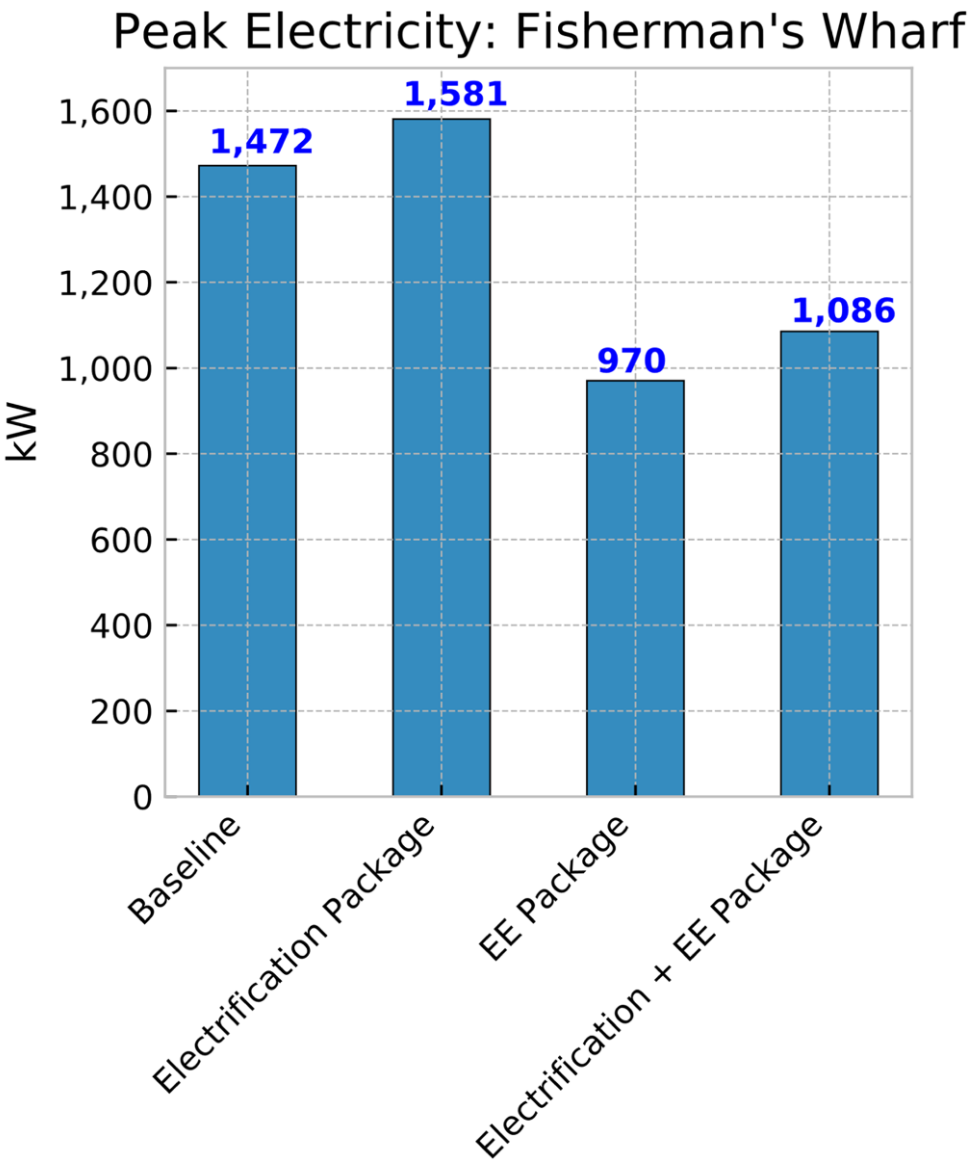

Lessons

Public data can answer electrification policy questions *

Efficiency improves confidence the grid can handle electrification

* This analysis does not substitute for grid planning

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More info: Hong T, et al (2023) Nexus of Electrification and Energy Efficiency Retrofit of Commercial Buildings at the District Scale, Sustainable Cities and Society Vol 95. https://doi.org/10.1016/j.scs.2023.104608

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DEPARTMENT

Speaker

Melanie Johnson

Electrical Engineering Researcher, US Army Engineer Research and Development Center Construction Engineering Research Laboratory

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Army Microgrid Implementation and Criteria Development

Melanie Johnson
Electrical Engineering Researcher
Construction Engineering Research Laboratory (CERL)
Engineer Research and Development Center (ERDC)

29 November 2023

Grid Modernization - Global Insight & Local Solutions

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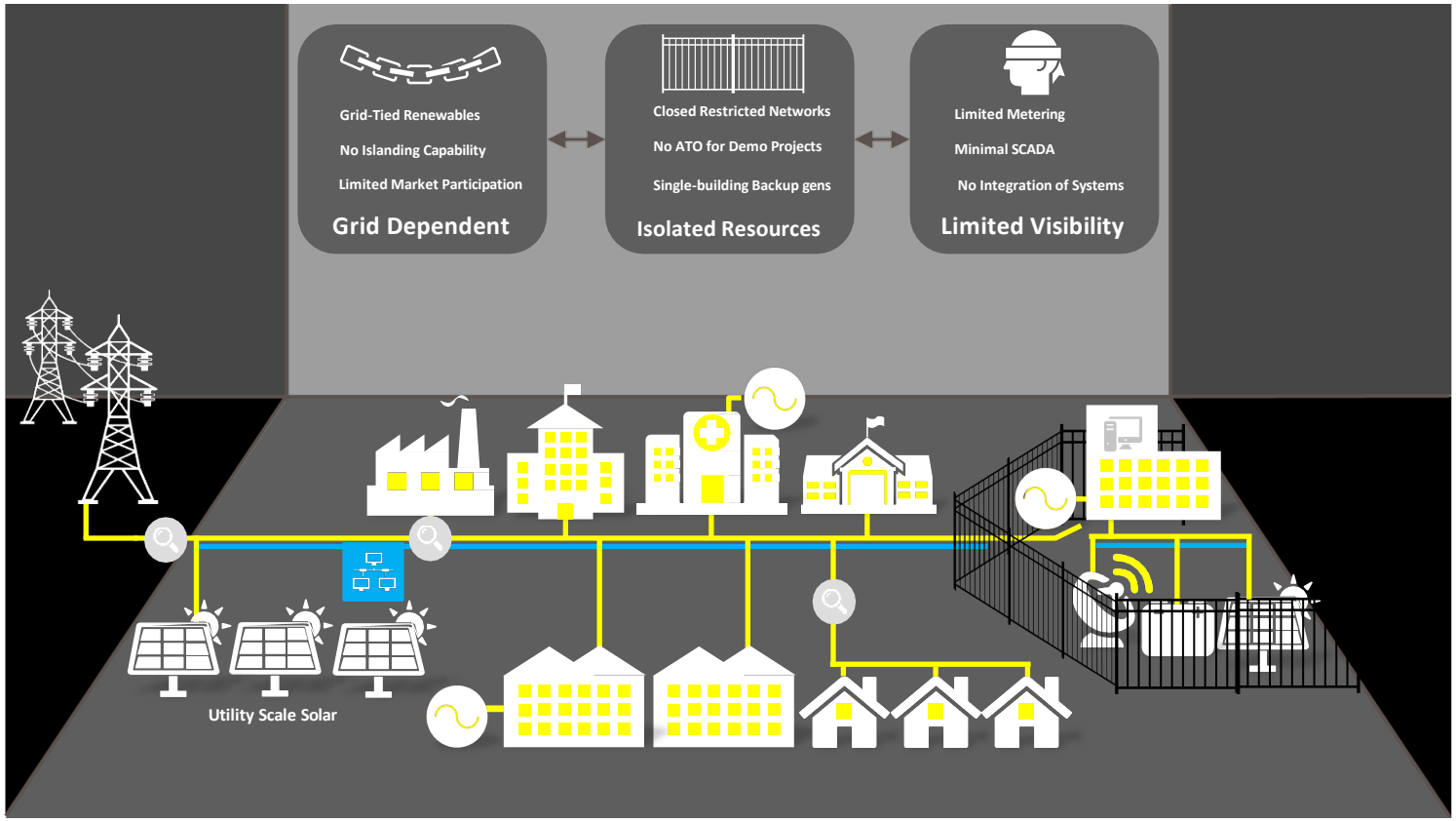
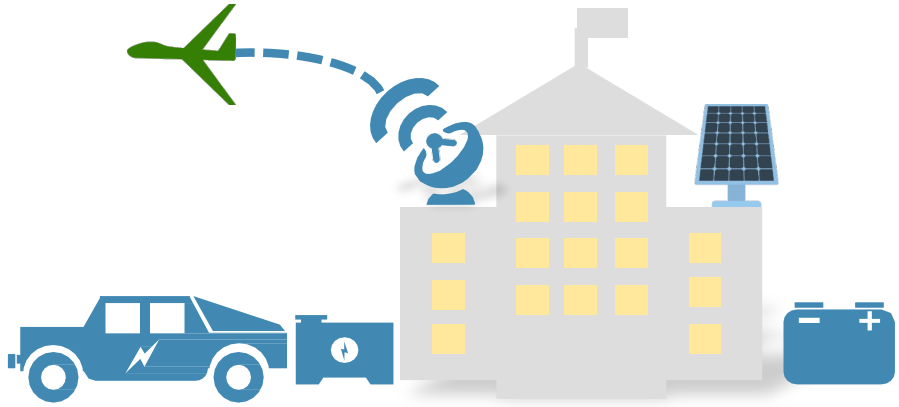
Electrical Distribution: Current State



Why Build Microgrids?

Army's Infrastructure Requirements Outpace Existing Capabilities.

- Power Quality and Reliability
- Distributed Generation Resources
- Security Posture/Resilience Requirement
- Electric Vehicles
- Decarbonization/Building Electrification



Policy Recognizes this Growing Issue

- Army Modernization Strategy, 2019[1]
- Army Installation Strategy, 2020[2]
- Army Energy and Water Strategic Plan, 2020[3]
- Army Climate Strategy, 2022[4]
- NDAA FY22§321, 2021[5]
- NDAA FY23§323, 328, 2022[6]

1 https://www.army.mil/e2/downloads/rv7/2019_army_modernization_strategy_final.pdf
2 https://armypubs.army.mil/epubs/DR_pubs/DR_a/ARN32810-SD_07_STRATEGY_NOTE_2020-01-000-WEB-1.pdf
3 https://www.asaie.army.mil/Public/ES/doc/Army_Installation_Energy_and_Water_Stategic_Plan_FINAL.pdf
4 https://www.army.mil/e2/downloads/rv7/about/2022_army_climate_strategy.pdf
5 https://www.congress.gov/bill/117th-congress/senate-bill/1605/text
6 https://www.congress.gov/bill/117th-congress/house-bill/7776/text

Army Climate Strategy

LINE OF EFFORT 1: INSTALLATIONS	
STRATEGIC OUTCOME:	
Enhance resilience and sustainability by adapting infrastructure and natural environments to climate change risks, securing access to training and testing lands into the future, and mitigating GHG emissions	
INTERMEDIATE OBJECTIVES:	
1.1	Install a microgrid on every installation by 2035
1.2	Achieve on-site carbon pollution-free power generation for Army critical missions on all installations by 2040
1.3	Provide 100% carbon-pollution-free electricity for Army installations' needs by 2030
1.4	Implement installation-wide building control systems by 2028
1.5	Achieve 50% reduction in GHG emissions from all Army buildings by 2032, from a 2005 baseline
1.6	Attain net-zero GHG emissions from Army installations by 2045
1.7	Field an all-electric light-duty non-tactical vehicle fleet by 2027
1.8	Field an all-electric non-tactical vehicle fleet by 2035
1.9	Continue to advocate for an expanded Army Compatible Use Buffer
1.10	Include climate change threat mitigation into Army land management decisions
1.11	Incorporate the latest climate and environmental science into stationing, construction, and fielding decisions

Ambitious goal for Army Energy Resilience.

- Over 130 Installations Worldwide
- Priority given to:
  - Mission Assurance Installations
  - Mobilization Force Generation Installations
  - Power Projection Platforms[1]

The U.S. Army consumed ~10.7 TWh of electrical energy in FY22[2].

…Or used roughly 29 GWh per day.

1 https://www.army.mil/e2/downloads/rv7/about/2022_army_climate_strategy.pdf
2 https://www.acq.osd.mil/eie/Downloads/IE/FY22%20AEPRR%20Report.pdf

Army Microgrid Capacity Requirements

Army installations are directed to sustain themselves through a 14-day utility outage.

29GWh/Day * 14 Days =
410GWh of Microgrid Energy reserves.
(241 BILLION AA Batteries!)

Caveat: Not all missions and energy consumption are critical – this is still a substantial microgrid implementation plan.

As of February 2023, Army has

~10 Microgrids

that contribute these requirements.

Army Directive 2020-03
(Installation Energy and Water Resilience Policy)

The Army will sustain critical missions by being capable of withstanding an extended utility outage for a duration set by the senior commander or higher 2 headquarters based on timeframes to accomplish, curtail, or relocate the critical mission(s).When the duration of the critical mission(s) has not been stipulated, the **Army will plan to sustain energy and water for a minimum of 14 days[1].**

1 https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN21689_AD2020_03_FINAL_Revised.pdf

Army Microgrid Implementation Plan

FY 24: 20 Microgrid Projects in Design or under Construction

FY 26: 15 Operational Microgrids

FY 27: 20 Operational Microgrids

FY 27: Microgrid coverage of 30% of critical mission demand

FY 27: Microgrid coverage of 50% to prioritized demand[1]

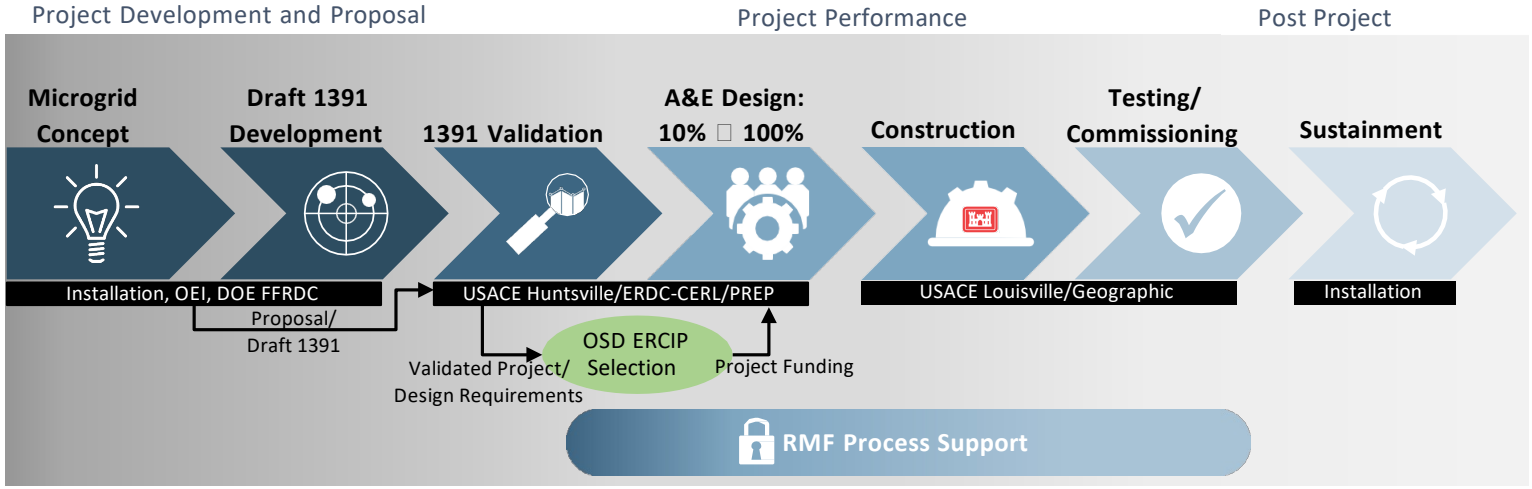
Funding:

- Energy Resilience and Conservation Investment Program (ERCIP)
- Third-Party Financing:
  - Energy Savings Performance Contracting (ESPC)
  - Utility Energy Savings Contracting (UESC)

1 https://www.army.mil/e2/downloads/rv7/about/2022_Army_Climate_Strategy_Implementation_Plan_FY23-FY27.pdf

Army Microgrid Implementation Plan

- U.S. Army Corps of Engineers manages microgrid design & construction
- New Criteria and Specifications:
  - Unified Facilities Criteria (UFC) 3-550-04: Installation Microgrid Design
  - MIL-STD-3071 Tactical Microgrid Communications and Controls
  - Unified Facility Guide Specification: Microgrid Controllers, coming in Dec 2023

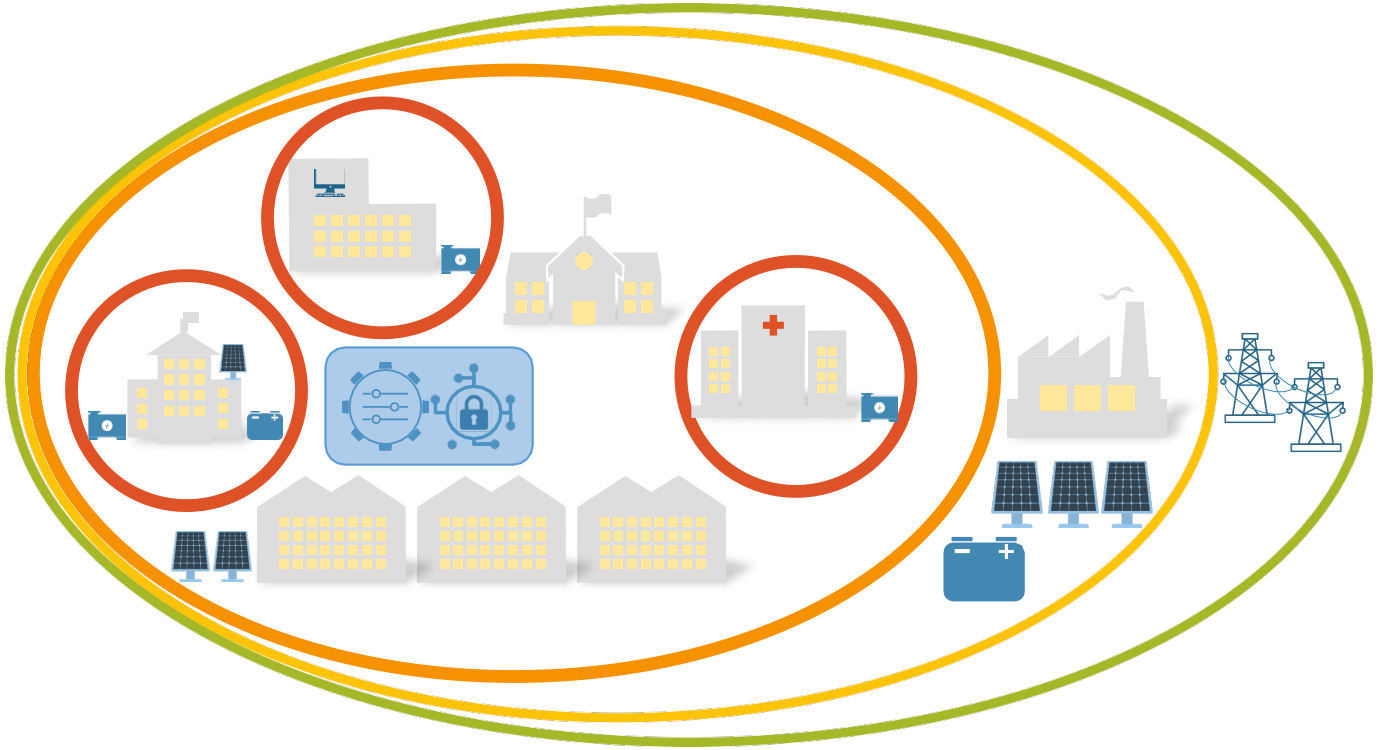


Key Design Aspects

- Design Basis – clearly define and document the objective of the microgrid
- Artificial Constraints – promises made become design constraints
- Do No Harm – existing backups should maintain functionality, reliability should improve
- Maintainable Choices – design for easy maintenance for better long term results.
- Define the CONOPS – Document the who/what/when/how for microgrid operation

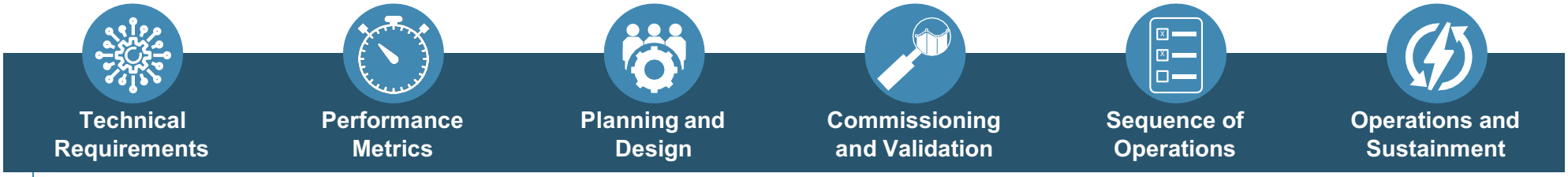
Microgrids Enable Energy Resilience

When the situation degrades, the most critical loads must stay on.



Resilient Installation Microgrid Design (UFC 3-550-04)

This Unified Facilities Criteria (UFC) provides guidance on installation microgrid design requirements, performance metrics to inform design, sequence of operations, commissioning and validation, and sustainment. Design tenets and criteria contained herein are intended to ensure resilient, robust, and standardized solutions based on performance-based criteria and best design practices.



- **Open, Performance-based Design Standard (not prescriptive)**
- **UFC Relies on Service Policy and Mission Requirement to Inform the Performance Requirement; Only the Performance Requirement informs Design (not tools or models)**
- **UFC is Architecture, Source, and Acquisition Agnostic**
- **UFC Accommodates widest "aperture" of design and acquisition vehicles, (including 3rd party financed) – minimize complexity and restrictive/prescriptive statements**
- **Networked back up power is complementary to traditional, facility-dedicated back up (defense-in-depth concept for energy resilience) – credit USAF**
- **Commissioning with emphasis on M&V, O&M, troubleshooting – credit USN**

Criteria Technical Highlights (UFC 3-550-04)

To be in compliance of the specified criteria, the design must include the following:

1. Be a Bounded System with autonomous (commercial grid-independent) generation, distribution, and controls
2. Be capable of islanding *with ability* to parallel and network more than one disparate source of generation (otherwise, system governed by UFC 3-540-01)
3. Be capable of grid-independent, autonomous black start
4. System Balancing: Contain grid-independent ability to energize critical loads and optimize load factor
5. Contain sufficient generating sources, reserve capacity, and stored forms of energy to meet the peak critical load within the system boundary with off-grid endurance not less than the duration of time required by service policy and mission
6. Fail-Safe Operation – Be able to revert to load dedicated operation following loss of communication, system fault, or other network impact during the course of operation
7. Include a Cybersecurity Authority to Operate (ATO) by a DoD Approving Official (AO)
8. Exclusive use of commercial, warrantied, non R&D technology intended to support permanent infrastructure improvement

Criteria Technical Highlights (UFC 3-550-04)

To <u>exceed</u> the specified criteria, the design may include any combination of the following:

1. Soft, "**blinkless**" Transition
   - Be capable of re-synchronization and soft (seamless) transition *to islanded operation*
   - Be capable of re-synchronization and soft (seamless) transition *back to the external grid*

2. **Energy Storage** – paralleling, forming, improved renewables utilization, power quality, blinkless transition, peak shaving or other grid incentives

3. **Redundant (min 2) grid forming assets** (generator or inverters)

4. **Redundant (min 2) HMI** Visualization Front-Ends

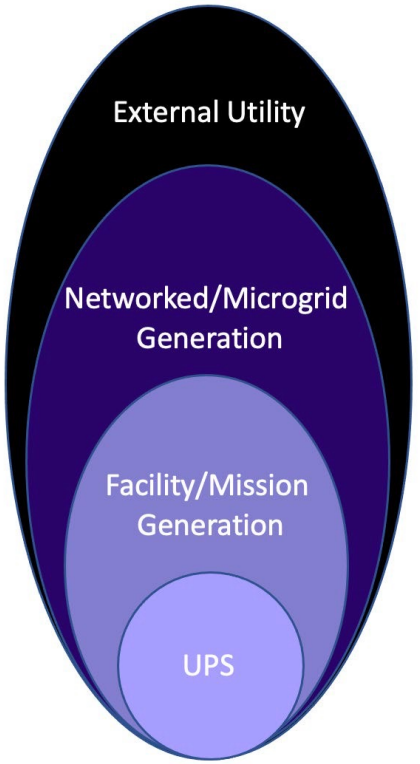
5. **Redundant (min 2) Independent Black Start Sources**

6. **Load Shedding** Capability or Prioritized load restoration

7. **Grid Connected Operation** – for load curtailment, demand response or grid services

Networked and Load-Dedicated Contingency Power (UFC 3-550-04)

- Networked back up power is complementary to traditional, facility-dedicated back up (defense-in-depth concept for energy resilience)
- Fail-Safe Operation is the ability to revert to load dedicated operation following critical system impact:
  - Loss of communication
  - System fault
  - Other network impact during the course of operation



Multi-Layered Approach to Contingency Power

Tactical Microgrid Standard (MIL-STD-3071)

TMS establishes the communication and control interface requirements for Tactical Microgrids (TMGs) to enable TMG components to operate as a single entity to provide electricity in a tactical environment. This standard defines the component interfaces of the hardware and software necessary to provide intelligent control, power quality, electrical stability, electrical performance, safety of personnel, security, and protection.

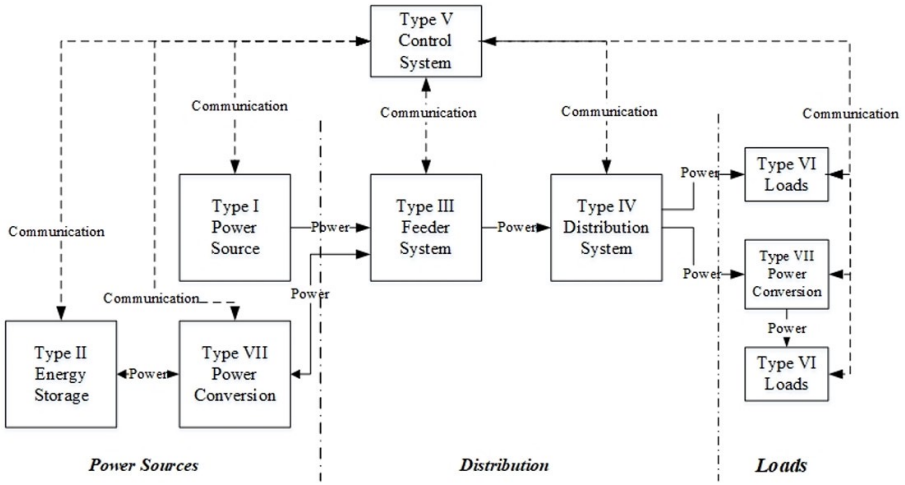


Figure 1 - Tactical Microgrid Schematic

- Specific to tactical microgrids (for now)
- Protocol/Data Model Only
- Under evaluation for adoption in installation (grid-scale) microgrids

Available for download: https://quicksearch.dla.mil/qaDocDetails.aspx?ident_number=285095

Microgrid Control System UFGS

This guide specification covers the requirements for a microgrid control system (MCS) Front End using open protocols. USACE is required to produce a draft by December 2023 (NDAA FY2023).

Definitions

System Descriptions

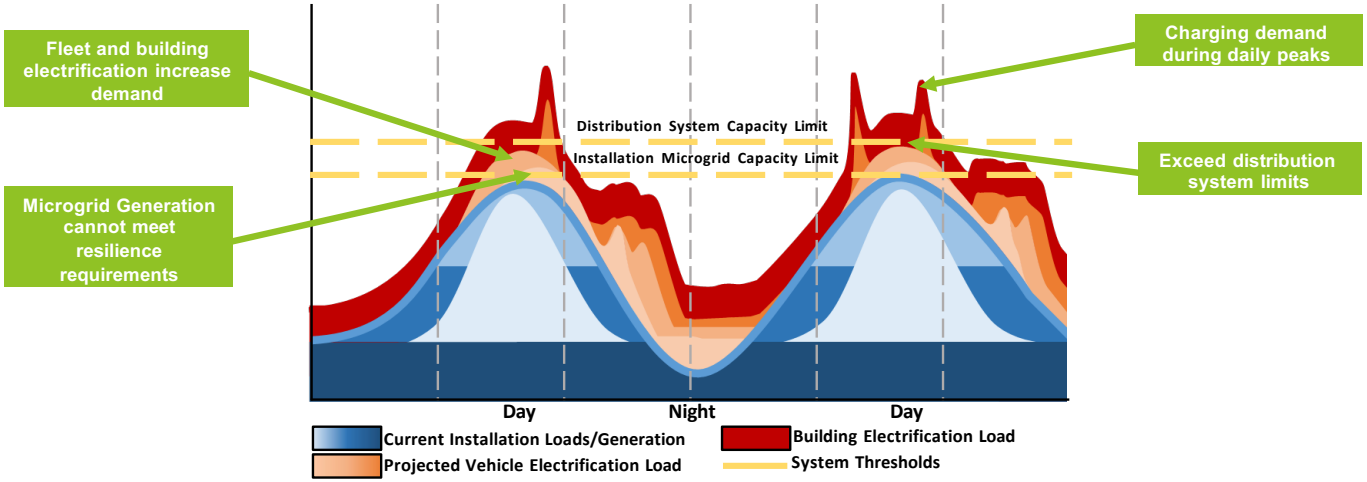
Project Execution

Protocols and Points Schedule

- **Conceptual Framework:** The conceptual framework will encompasses the primary, secondary, and tertiary control functions required for effective microgrid operation, irrespective of microgrid size, architecture, or specific DERs.
- **Technology Neutrality:** The completed guide specification will aim to be open and technology- neutral, allowing for flexibility and adaptability to evolving and emerging technologies and market trends.
- **Compliance with Standards:** Incorporate relevant industry standards, codes, and regulations governing microgrid control system design, cybersecurity, safety, and performance.

- **Communications Requirements:** Address the communications infrastructure requirements for microgrid control systems.
- **Interoperability:** The guide spec will promote interoperability among different components and subsystems within the microgrid control system.

Evolving Challenges

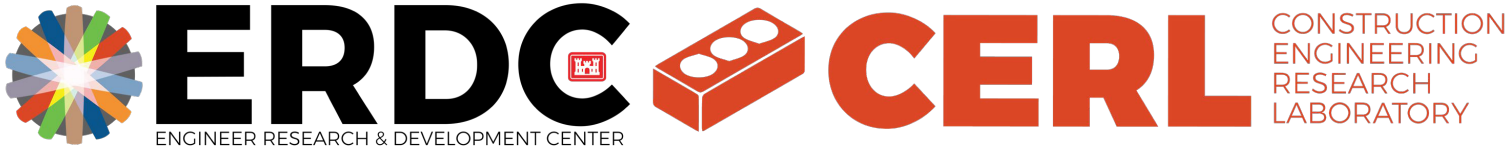


Requirements won't stand still.

- Vehicle Electrification intensifies critical load demand[1]
- Building Electrification increases critical base load[2]
- Decarbonization eliminates traditional fueled generation[2]
- Control Systems expand cyber attack surface

1 https://www.whitehouse.gov/briefing-room/presidential-actions/2021/12/08/executive-order-on-catalyzing-clean-energy-industries-and-jobs-through-federal-sustainability/
2 https://www.wbdg.org/ffc/dod/engineering-and-construction-bulletins-ecb/usace-ecb-2023-08

Thank you!


ERDC
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CONSTRUCTION
ENGINEERING
RESEARCH
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Speaker

Stephen Honikman

Vice President of Business Development, Electriq Power

LOCAL GOVERNMENT SUSTAINABLE ENERGY COALITION

CCEC

Expanding Access to Smart Behind the Meter Resources for a Better Future Grid

electriq power

By Stephen Honikman, VP Business Development

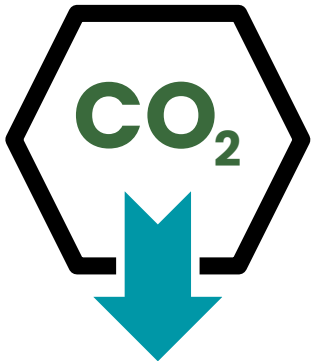
Future Grid Vision

Network of distributed energy resources (DERs) supporting and providing capacity to the existing electrical grid is a path towards a better future grid…

To accomplish this, we:

- Establish private & public partnerships working toward a common goal
- Eliminate financial barriers preventing low-to-moderate income household participation
- Ensure programs add value "for all three Ps" to align the solution for a better future grid

Common Goals



Decarbonization

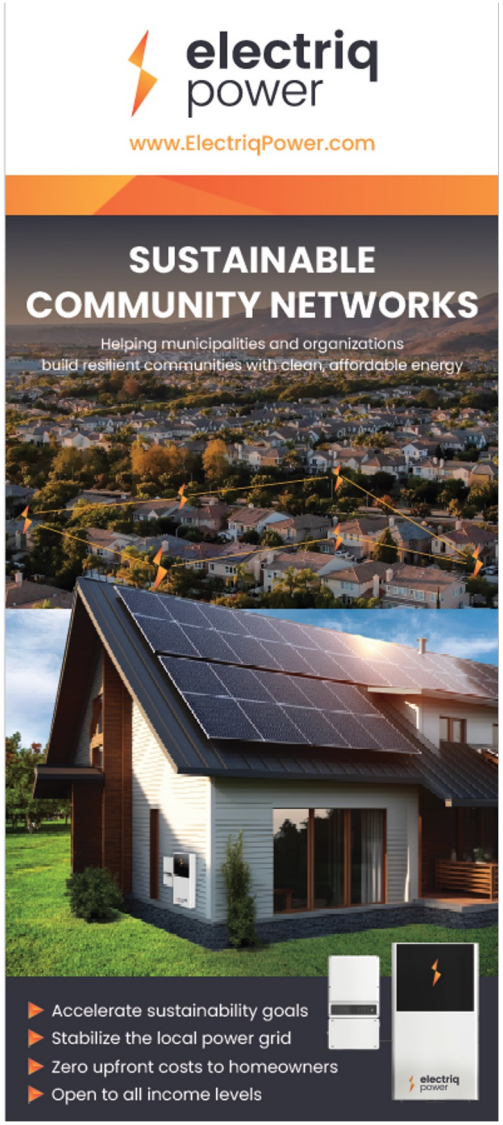
Resiliency

Health & Safety

Sustainable Community Solutions

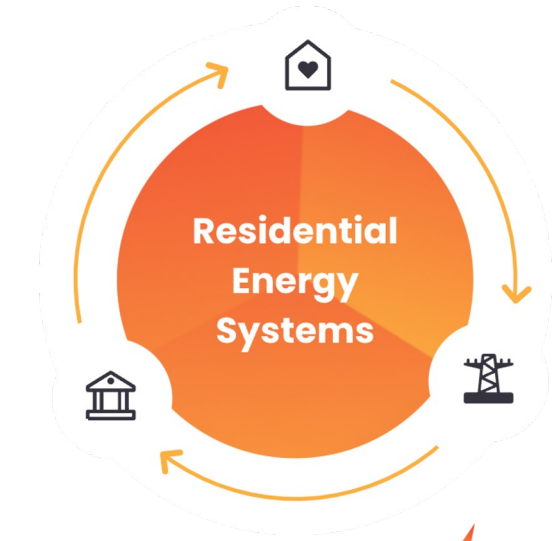
- Partnerships with local municipalities and community-based organizations to validate offerings
- Addresses financial barriers that restrict access
- Provide a turnkey solution that makes it easy to incorporate clean and smart energy solutions

"Developing programs that support the transformation of the electrical grid"



About Sustainable Community Networks

- Turnkey solution that incorporates clean and smart energy solutions for individuals and the community
- Access to residential solar + battery storage systems at ZERO upfront cost
- No income, credit score, deposit, or property lien requirements
- Open to all, but focused on low-to-moderate income communities, for broad community benefit



Opening Access

Improve Quality of Life*

Reduces impacts on overall health

Improved quality of air in the community

Increase Resiliency

Prepared for unexpected power outages

Grid stabilization

Safety & Security

Families stay safe in the home

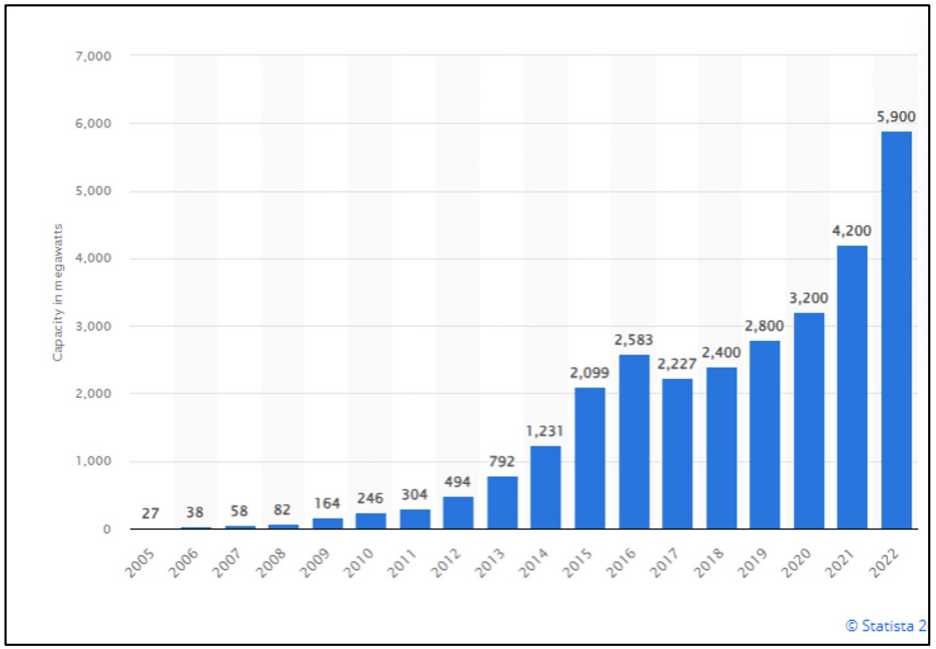
Critical infrastructure accessible

*https://www.epa.gov/clean-air-act-overview/progress-cleaning-air-and-improving-peoples-health

Grid Challenges are Opportunities

Expanding the number of Smart DERs is an opportunity for the future grid!

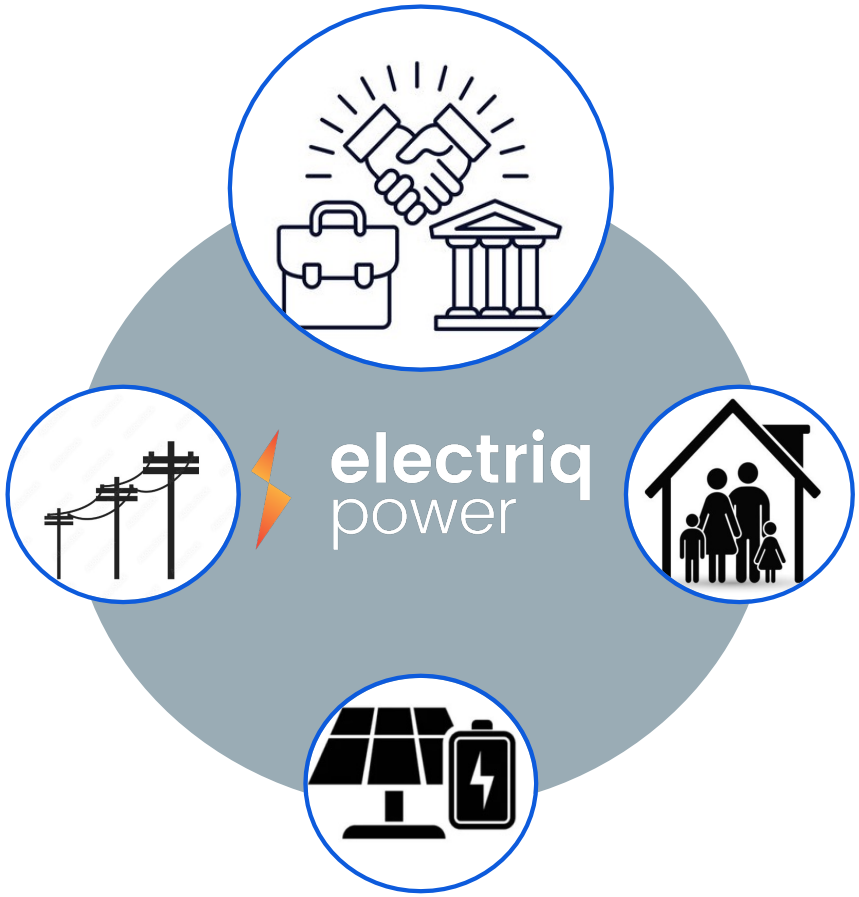
- Ability to support increased demand for electricity
- Addresses the “Duck Curve” and Peaks
- Dispatchable Behind-the-Meter storage
- Potential to lower or eliminate the need for growth of central generation



https://www.statista.com/statistics/185694/us-residential-annual-pv-installed-capacity-since-2005/

In Conclusion

- Solving entry barriers to clean energy for the LMI community
- Adding smart behind-the-meter resources becomes a key feature of the future grid
- Public/private partnership via SCN programs enable stakeholder alignment



https://www.statista.com/statistics/185694/us-residential-annual-pv-installed-capacity-since-2005/

Audience Q&A

Send your questions in the Q&A box!

THANK YOU!

For your attendance!

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