Open Mic Science

Grid, or No Grid? —That is the Question!

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Bainbridge Island

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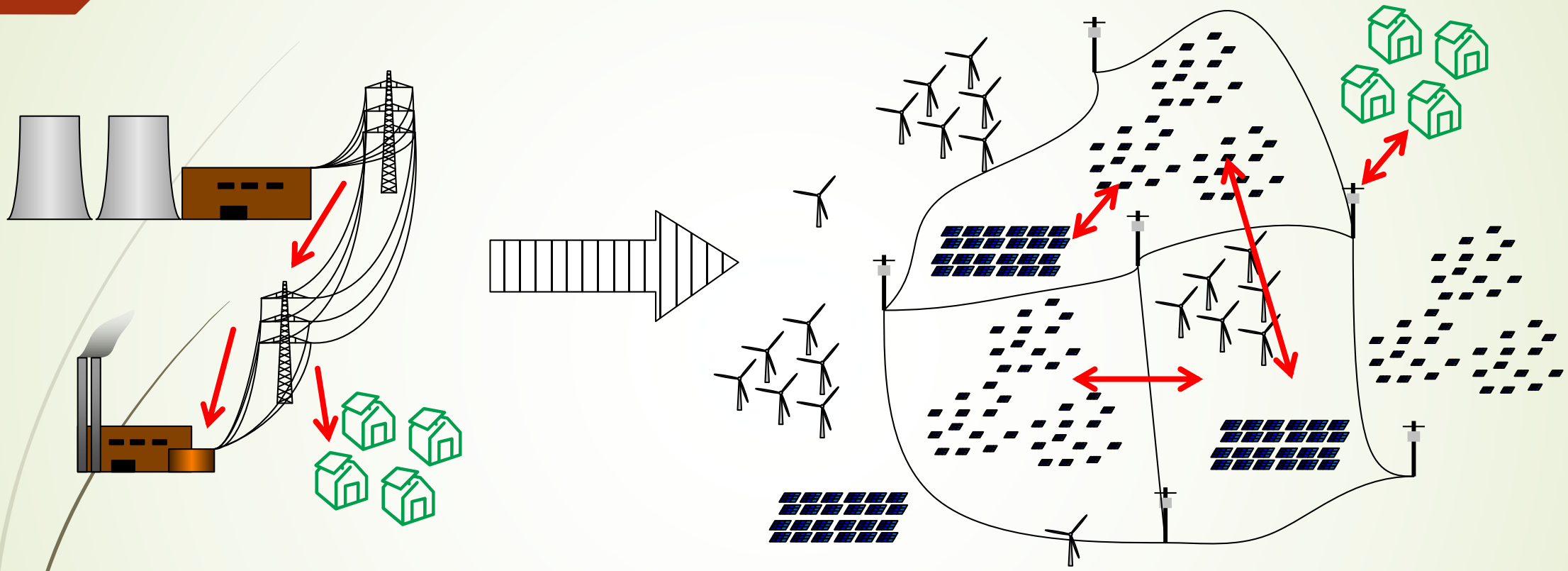
Disclaimers

- The presenter is an employee of EPRI, the world's preeminent independent, non-profit energy research and development organization, with offices around the world. EPRI's trusted experts collaborate with more than 450 companies in 45 countries, driving innovation to ensure the public has clean, safe, reliable, affordable, and equitable access to electricity across the globe. **The views presented in this presentation shall not be considered the official position of EPRI or any of its members.**

- The presenter is currently a member of the Climate Change Advisory Committee of the City of Bainbridge Island. The committee serves as a technical and planning advisory committee on issues related to climate change as directed by the City Council. The committee is also focused on the implementation of the Climate Action Plan, identified as the City Council's top policy priority. **The views presented in this presentation shall not be considered the official position of the City of Bainbridge Island or City Council.**

Trends and Emerging Needs

Structural Transformation of The Grid

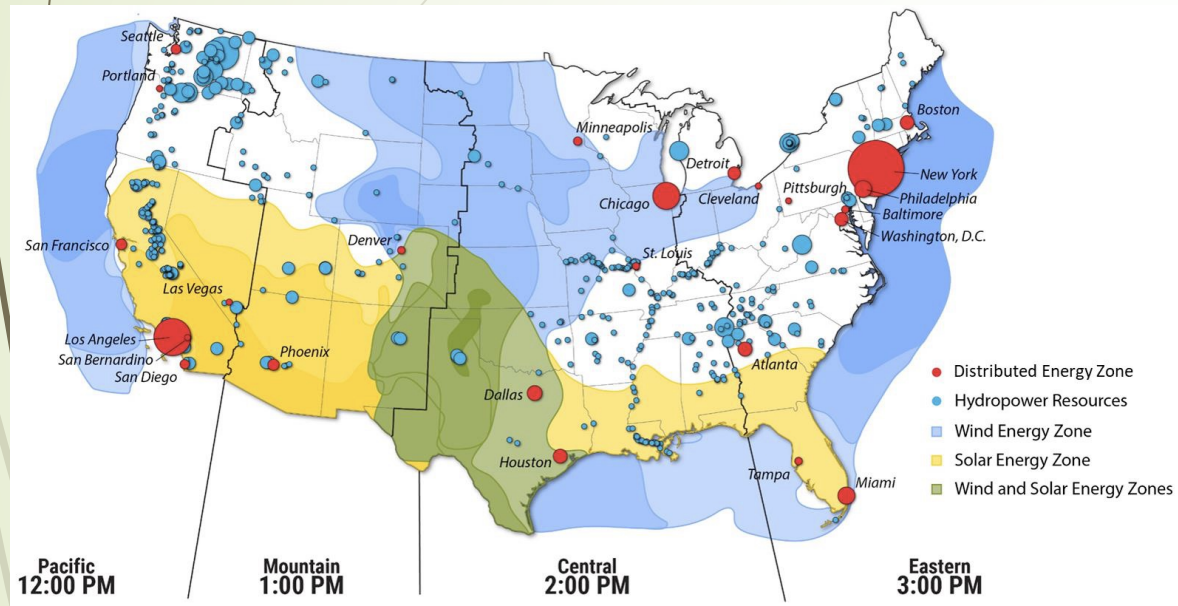


Power systems are being transformed from vertically-designed systems with unidirectional power flows to horizontally-designed systems with bidirectional power flows.

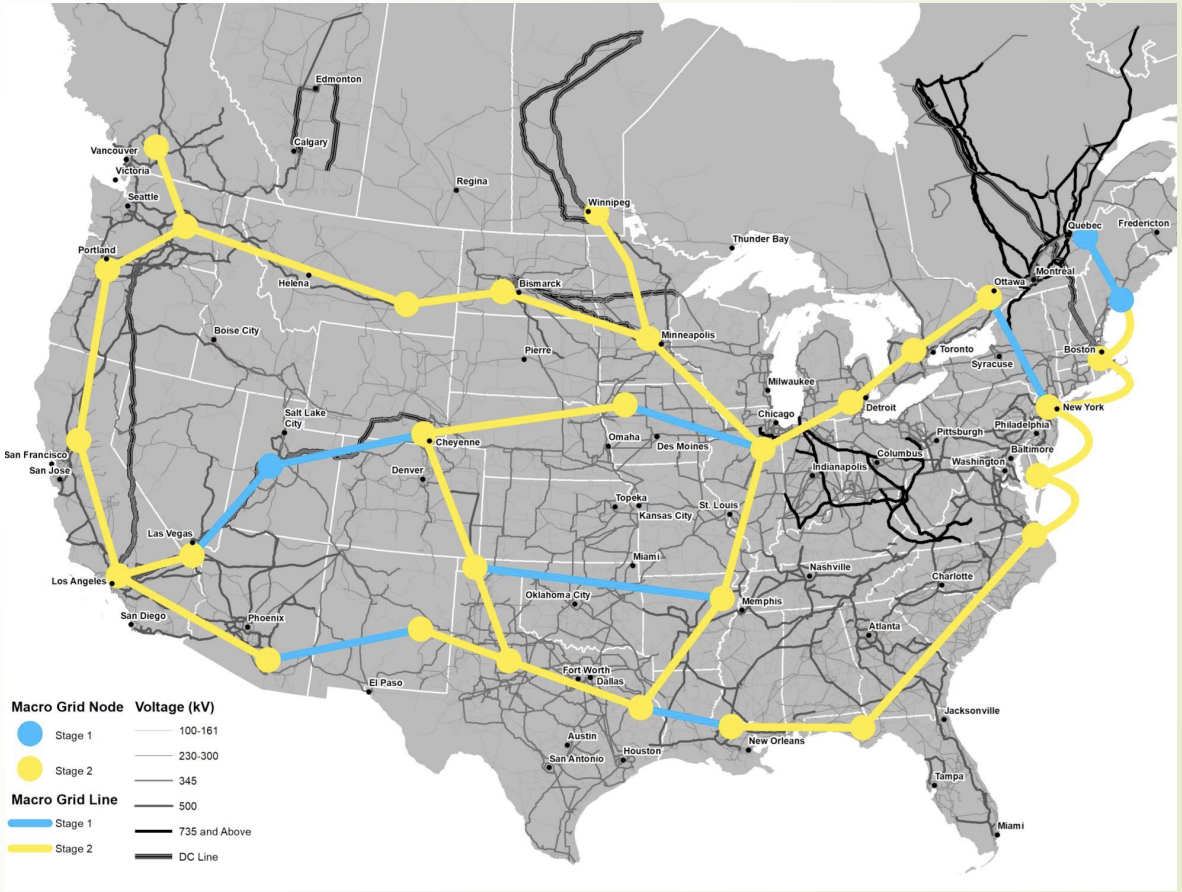
Source: Boemer, J. (2016). *On Stability of Sustainable Power Systems: Network Fault Response of Transmission Systems with Very High Penetration of Distributed Generation*. [Dissertation (TU Delft), Delft University of Technology]. https://doi.org/10.4233/uuid:78bffb19-01ed-48f9-baf6-ffb395be68a0

Transmission Grid Helps Integrate Renewables

Renewable Energy Zones

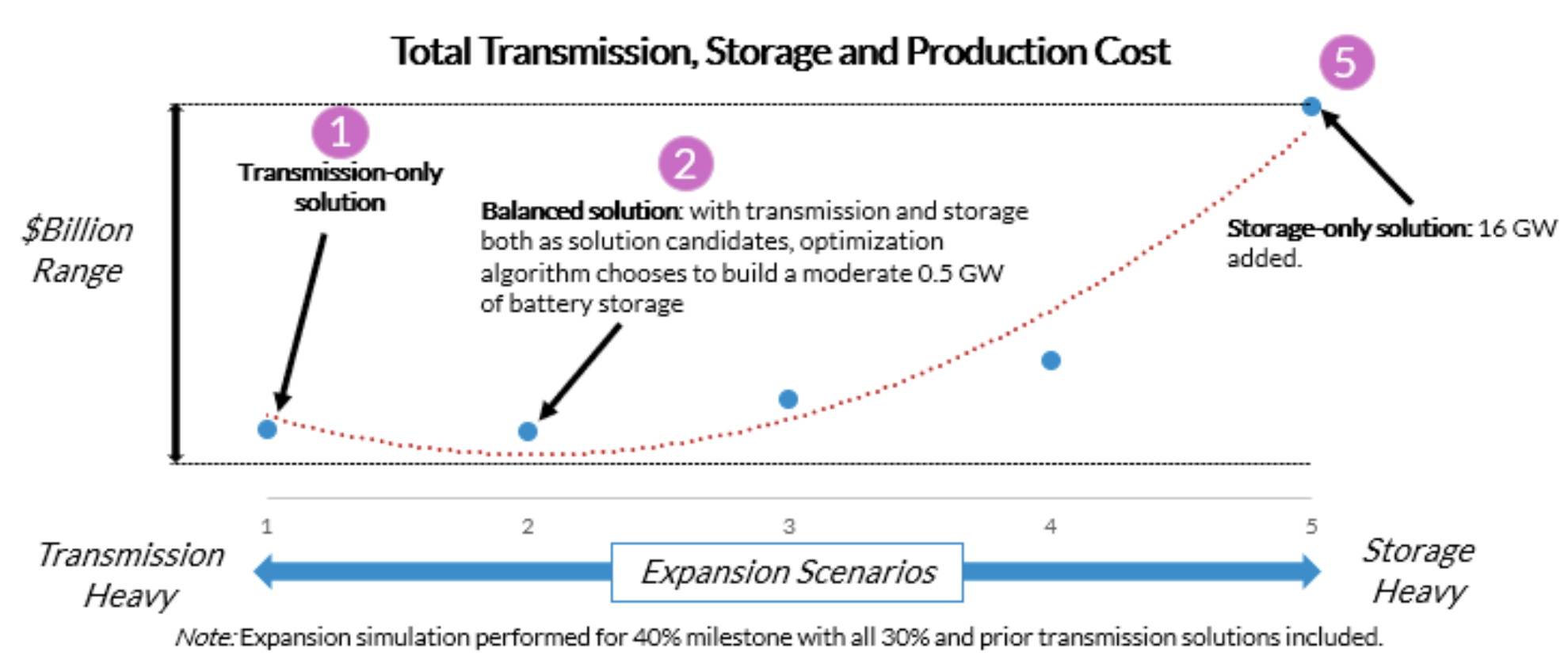


Vision for a U.S. Macrogrid



Source: Transmission Planning for 100% Clean Electricity. Energy Systems Integration Group (ESIG). February 2021. [Online]

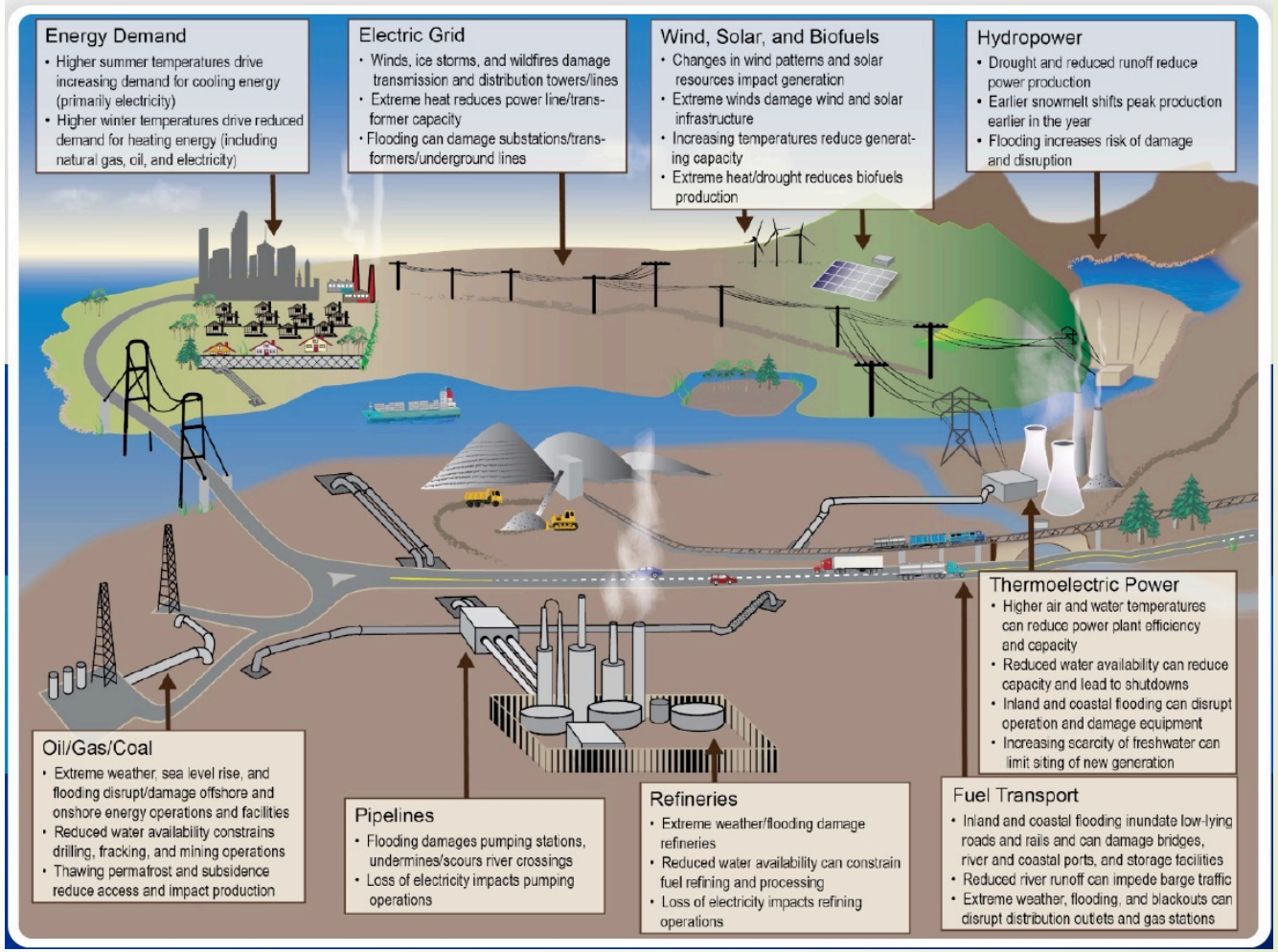
Storage Cannot Replace Transmission Grid Upgrades Cost-Effectively



Source: MISO's Renewable Integration Impact Assessment (RIIA). Midcontinent Independent System Operator, Inc.. February 2021. [Online]

Potential Energy System Impacts From Extreme Weather and Climate Change

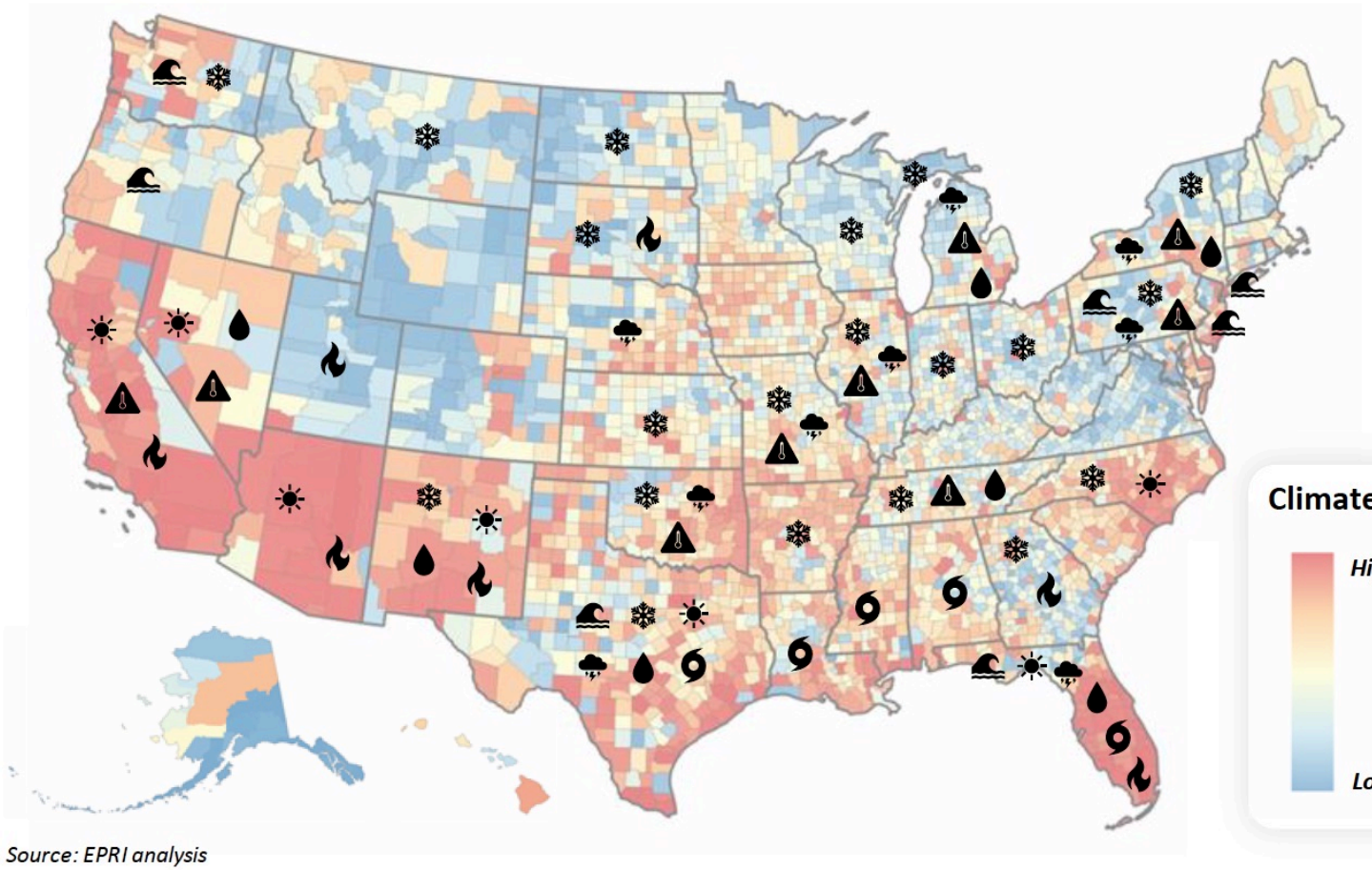
- Climate change impacts all aspects of the energy system



Source: Climate READi. Power Resilience and Adaptation Initiative. EPRI. Palo Alto, CA: 2023. [Online]

Acute Climate Risks Vary by Location

FEMA Climate Risk index = Expected Annual Loss * Social Vulnerability / Community Resilience



Climate Risk

High

Low

FEMA National Risk Index for Natural Hazards
(climate-related hazards only shown here)

- **Coastal flooding**
- **Cold, ice, snow**
- **Drought**
- **Storms**
- **Heat waves**
- **River flooding**
- **Hurricanes**
- **Wildfires**

Source: EPRI analysis

Source: Climate READi. Power Resilience and Adaptation Initiative. EPRI. Palo Alto, CA: 2023. [Online]

Emerging Technologies and Potential Solutions

One Example for How the Energy Industry Responds to these Challenges

EPRI Climate Resilience and Adaptation Initiative (READi)

- **COMPREHENSIVE:** Develop a *Common Framework* addressing the entirety of the power system, planning through operations
- **CONSISTENT:** Provide an informed approach to climate risk assessment and strategic resilience planning that can be replicated
- **COLLABORATIVE:** Drive stakeholder alignment on adaptation strategies for efficient and effective investment

Deliverables: Common Framework "Guidebooks"

- Climate data assessment and application guidance
- Vulnerability assessment
- Risk mitigation investment
- Recovery planning
- Hardening technologies
- Adaptation strategies
- Research priorities

Source: Climate READi. Power Resilience and Adaptation Initiative. EPRI. Palo Alto, CA: 2023. [Online]

EPRI Climate READi Definition of Resilience

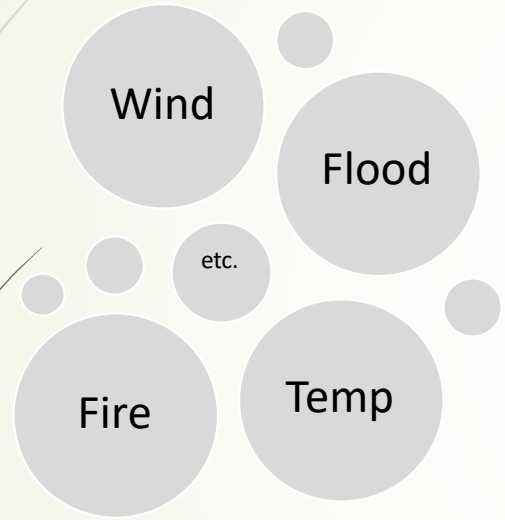
"Resilience itself can be difficult to grasp as a topic, as there are a variety of definitions and an even wider variety of spaces in which resilience can be applied. For the purposes of this effort, ***resilience is defined as the ability to anticipate, prepare for, respond to, and recover from potentially disruptive events, ideally while maintaining an adequate level of system function and with minimum damage or adverse impact****. This definition aligns with those used by other infrastructure-focused organizations and efforts, such as the National Infrastructure Advisory Council, the Federal Energy Regulatory Commission (FERC), and Presidential Policy Directive 21."*

Definitions revolve around the ability to anticipate, prepare for, respond to, and recover from HIGH-IMPACT, LOW-FREQUENCY threats with minimal damage.

Source: Climate READi. Power Resilience and Adaptation Initiative. EPRI. Palo Alto, CA: 2023. [Online]

Distribution Grid Must Become More Resilient

Climate Hazards



HIGH-IMPACT, LOW-FREQUENCY threats

Dx Planning Framework

Anticipate, prepare, respond, and recover

Adaptations

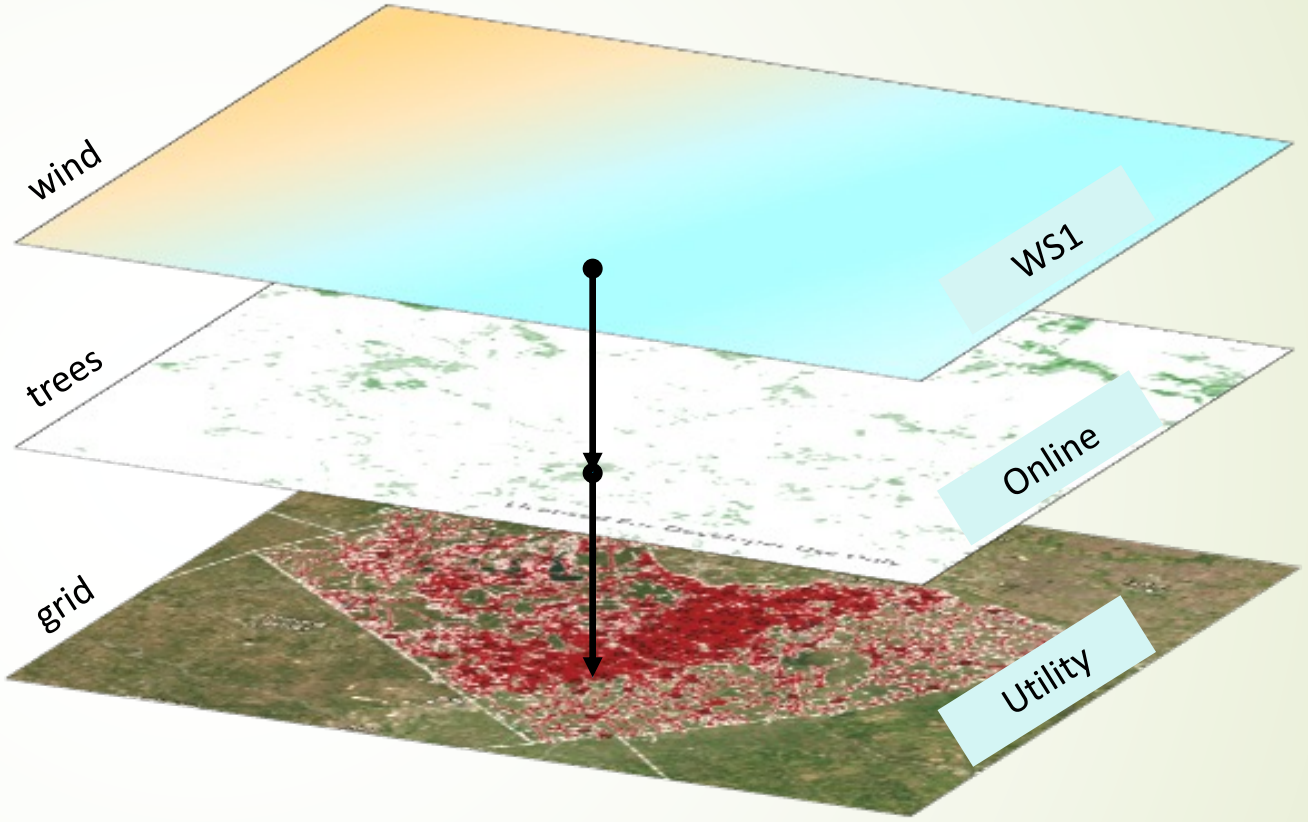
- **Undergrounding**
- **Pole Hardening**
- **Veg. Management**
- **Reconfigurability**
- **Automation**
- **DER**
- **Etc.**

Goal: Develop a framework to prioritize distribution investments & inform strategic planning decisions

Source: Climate READi. Power Resilience and Adaptation Initiative. EPRI. Palo Alto, CA: 2023. [Online]

Exposure – Informed by Geographic Layers

- Grid
- Climate Hazards
- Environment
- Etc.

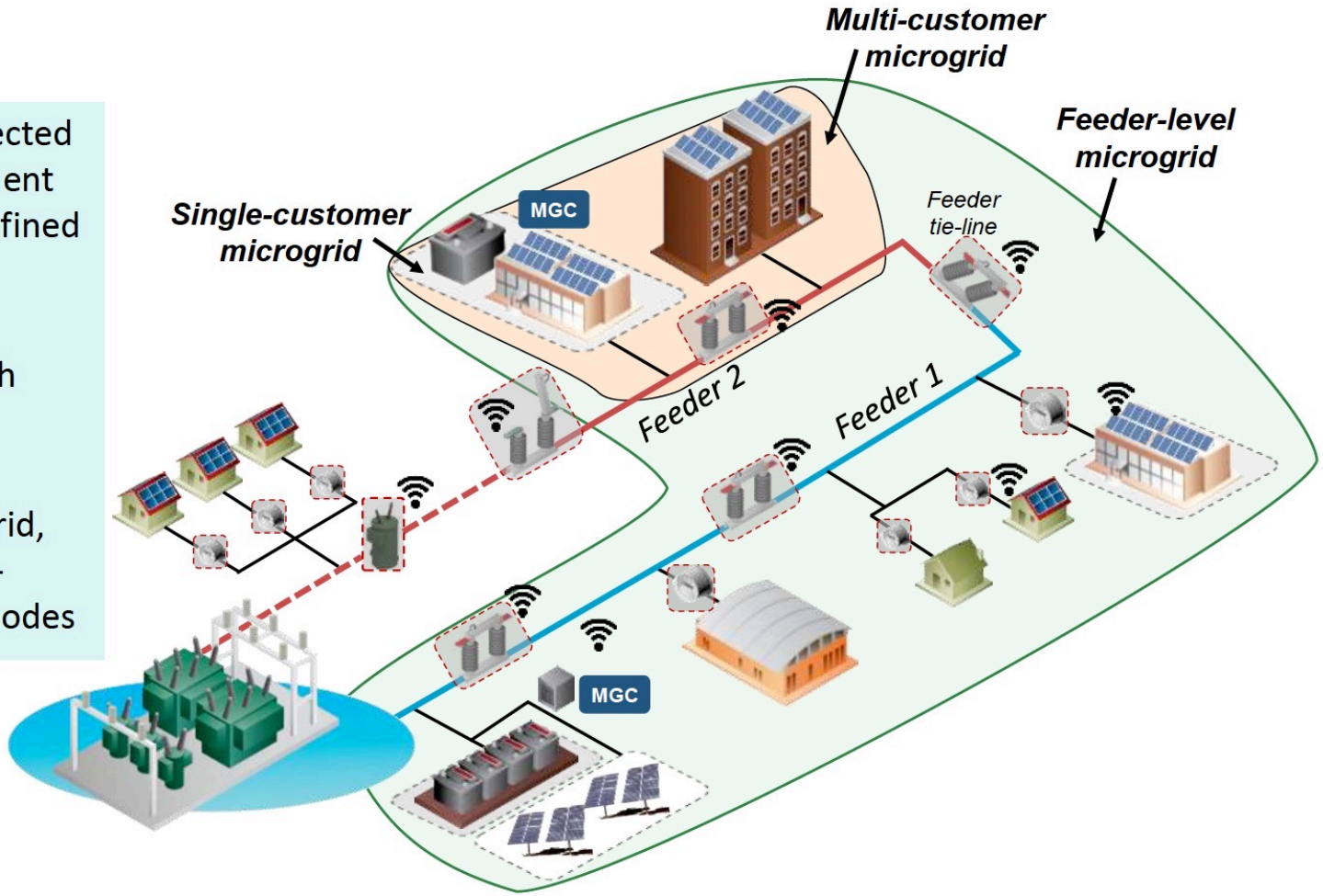


Multiple layers are brought together to find their intersections and identify exposed assets.

Source: Climate READi. Power Resilience and Adaptation Initiative. EPRI. Palo Alto, CA: 2023. [Online]

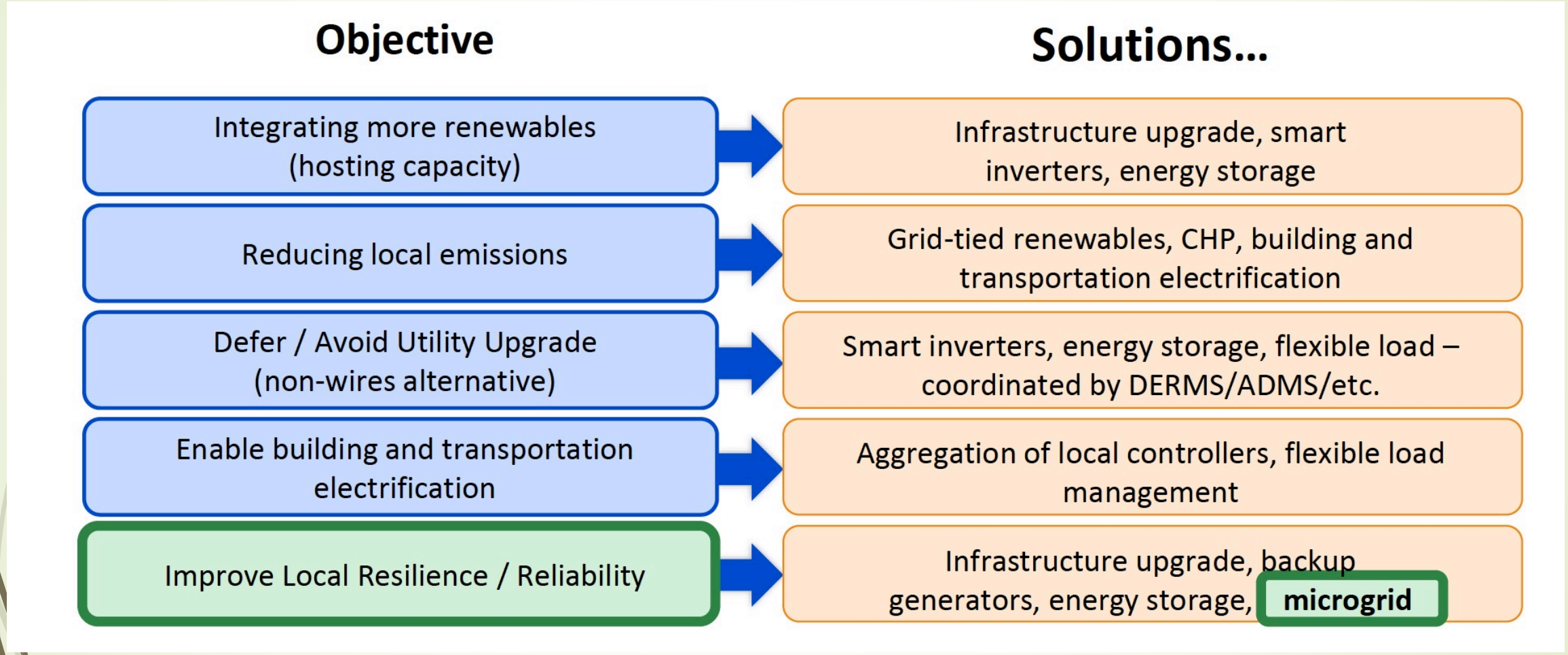
EPRI's Definition of "Microgrid"

1. A group of inter-connected loads and DER equipment and devices, within defined electrical boundaries.
2. Acting as a single controllable entity with respect to the grid.
3. Able to connect and disconnect from the grid, operating in both grid-connected or island-modes



Source: Climate READi. Power Resilience and Adaptation Initiative. EPRI. Palo Alto, CA: 2023. [Online]

Reasons to Build a Microgrid—Use Cases



Source: Climate READi. Power Resilience and Adaptation Initiative. EPRI. Palo Alto, CA: 2023. [Online]

Microgrids & Resilience Technology & Demonstration Landscape

Customer-Owned Community

Utility Managed Community

Solar+ES+EV Charging Microgrid

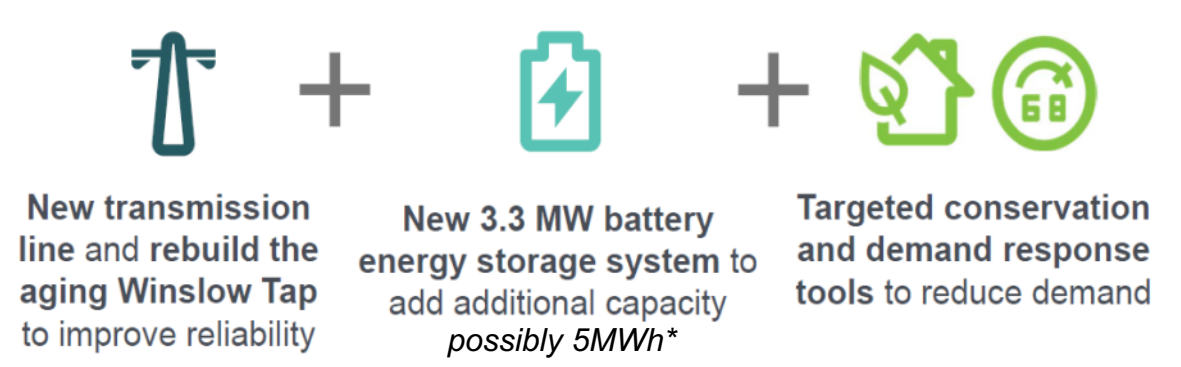
EV as Dispatchable Assets

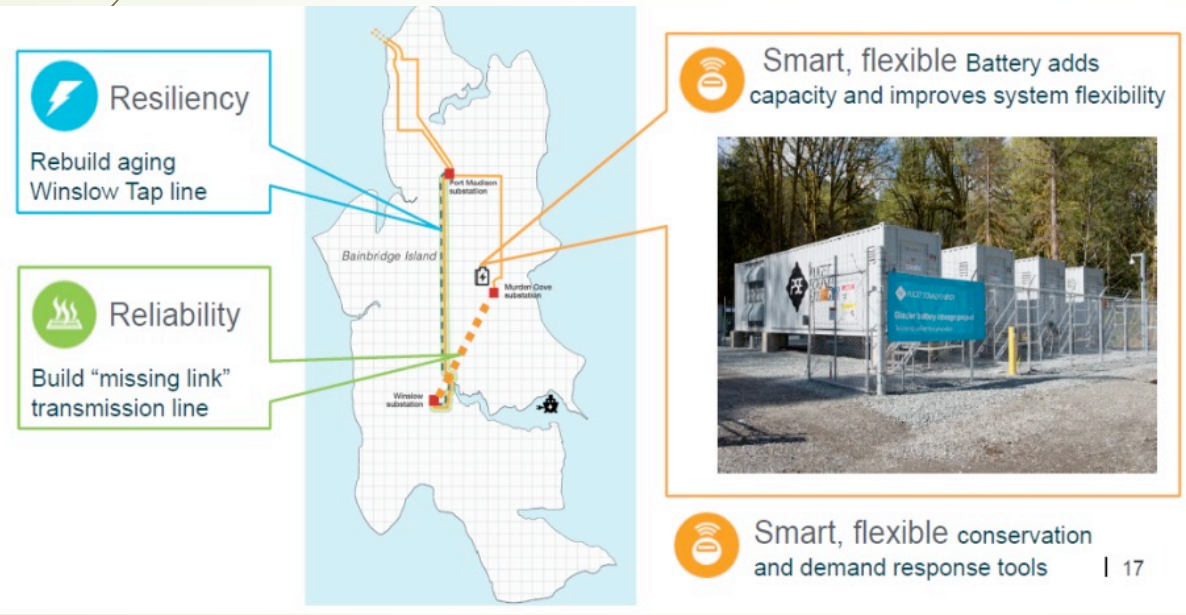
Utility-Operated
in Front of the Meter DERs

Utility Operated DERs during PSPS

Source: Climate READi. Power Resilience and Adaptation Initiative. EPRI. Palo Alto, CA: 2023. [Online]

Could PSE's Bainbridge Island Reliability Solution Be Expanded for More Local Resilience?

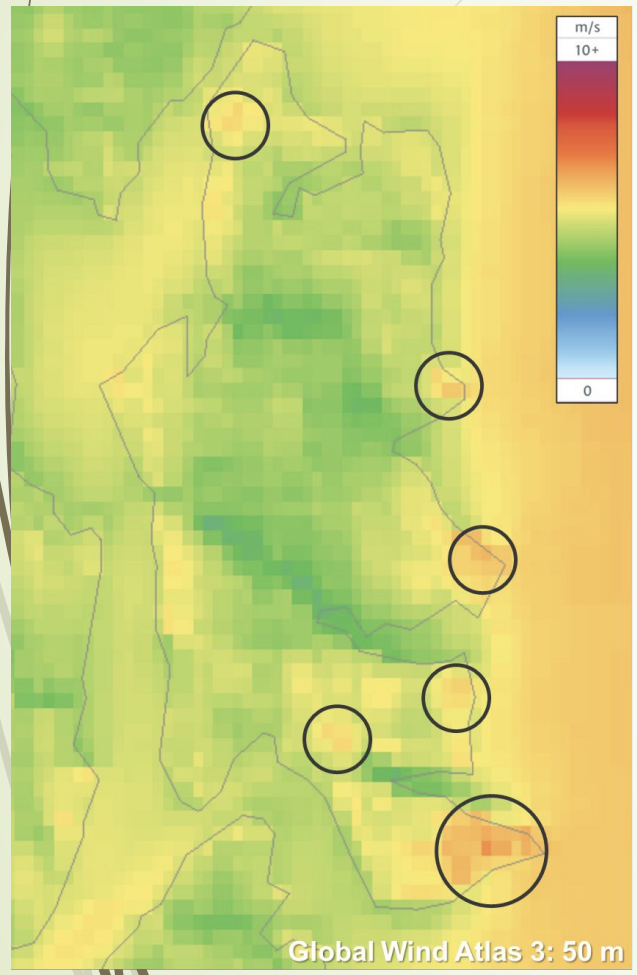




Source: PSE on bainbridge island. Reliability and grid modernization. Puget Sound Energy: 2023 [Online]

Challenge: Local Energy Resources Are Limited

- Limited Wind Resource



- Limited Solar Resource

Pathways to serve Island's 2022 Electric Demand

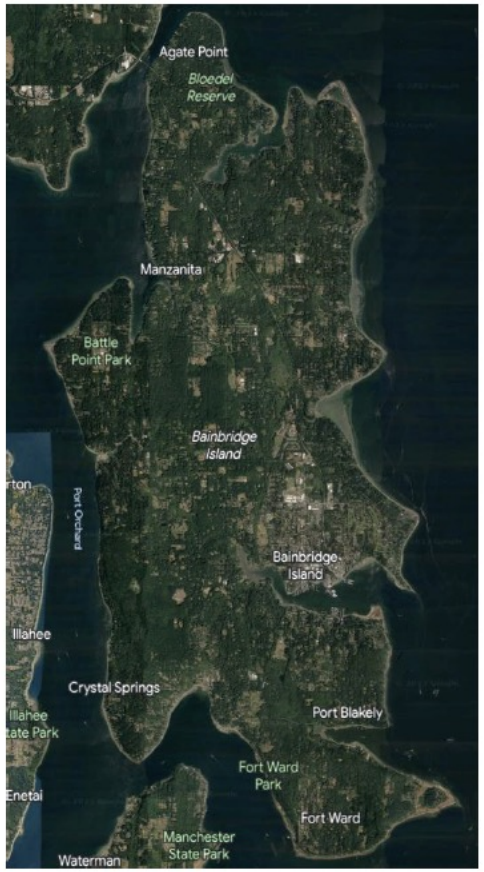
- Pathway #1: ~8%
  +
- Pathway #2
  —Rooftop Solar: ~23%
  —Additional Solar: 69%*

*Carport Solar PV

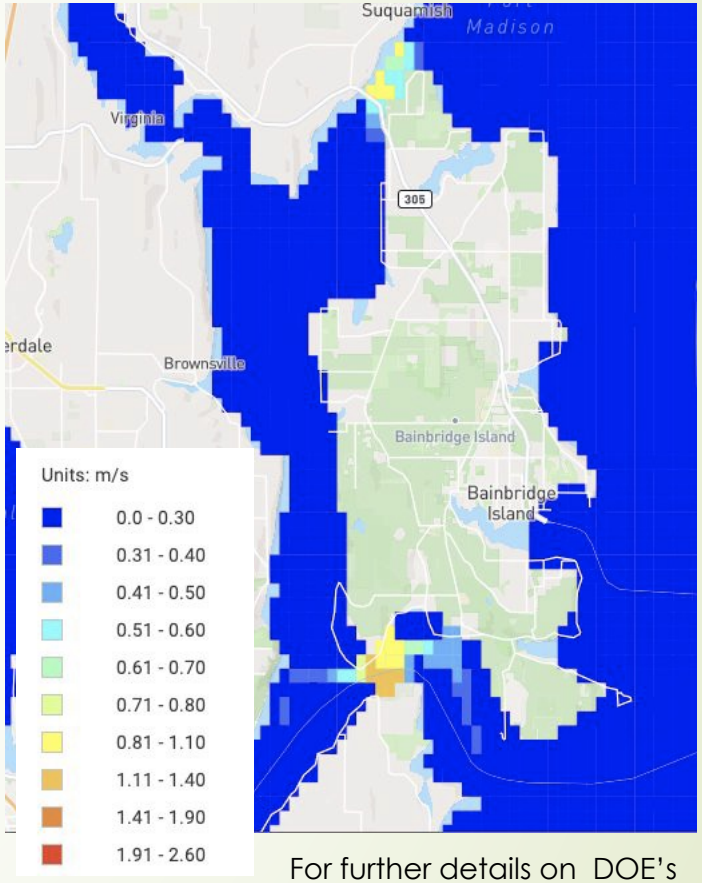
~ 345 acres

~ 475 acres

*Ground-mounted solar PV



- Limited Marine Energy



For further details on DOE's Energy Transitions Initiative Partnership Project (ETIPP Community Technical Assistance Program) refer to COBI's website here.

Source: U.S. Department of Energy's Energy Transitions Initiative Partnership Project (ETIPP). Presentation and Discussion. Agenda Package for COBI CCAC Meeting on Nov 15, 2023. [Online]

What Do I Want?

Status Quo

Complete dependency on PSE's grid.

Challenges with electric service reliability.

No changes in behavior.

Possible Future

Some independence from PSE's grid—
Invest into Community Solar, Rooftop Solar, and/or Storage. Accept visual and other impacts from local generation sites.

Improved electric service reliability and resilience—
Support PSE to implement their proposed reliability projects. Encourage PSE to explore additional use cases for their battery energy storage system.

Some changes in my behavior—
Install a Smart Thermostat, sign up for PSE's Demand Response Programs, get accustomed to some changes in room or water temperature.

Thank You!

Questions?

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