



Pacific Northwest
NATIONAL LABORATORY

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Energy and Water Resilience

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Examples of PNNL Experience with Microgrid Projects

- ▶ Economic Valuation, Analysis, and Models
 - Massachusetts
 - Oregon
 - Washington

- ▶ Resilience
 - Resilient microgrids for urban cores
 - Alaska Microgrid Partnership
 - LPNORM
 - SPIDERS
 - Energy and Water Resilience Assessments for DOD
 - Future Contingency Base Energy



Energy and Water Resilience

Energy and Water Resilience is:

The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from (energy and water) disruptions (to energy and water systems) that impact mission assurance.

- ▶ Anticipate – threats and vulnerabilities
- ▶ Prepare – design solutions
- ▶ Adapt – implementation and emergency planning
- ▶ Withstand – sustainable operations and hardening
- ▶ Respond – operations and decisions about alternative operations
- ▶ Recover – reconnecting to the world and helping the world reconnect

The graphic features the words 'ENERGY' and 'WATER' in white, with an ampersand '&' in yellow between them. To the left is a hexagonal icon containing a glowing yellow lightbulb, and to the right is a hexagonal icon containing blue water with bubbles. The word 'Resilience' is written in a large, yellow, sans-serif font to the right of the icons.

- ▶ **WHEN** you need it
- ▶ **WHERE** you need it
- ▶ **AS LONG AS** you need it

Resilience Requirements: When? Where? How Long?



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ENERGY
&
WATER

Resilience

- ▶ **WHEN** you need it
- ▶ **WHERE** you need it
- ▶ **AS LONG AS** you need it

- ▶ Power outage
- ▶ Broken water main
- ▶ Insufficient supply from grid
- ▶ Demand side management
- ▶ Others...

ENERGY
&
WATER

Resilience

- ▶ **WHEN** you need it
- ▶ **WHERE** you need it
- ▶ **AS LONG AS** you need it

- ▶ Critical mission functions & ancillary loads
- ▶ Basic health and safety
- ▶ Food supply
- ▶ Others...

ENERGY
&
WATER

Resilience

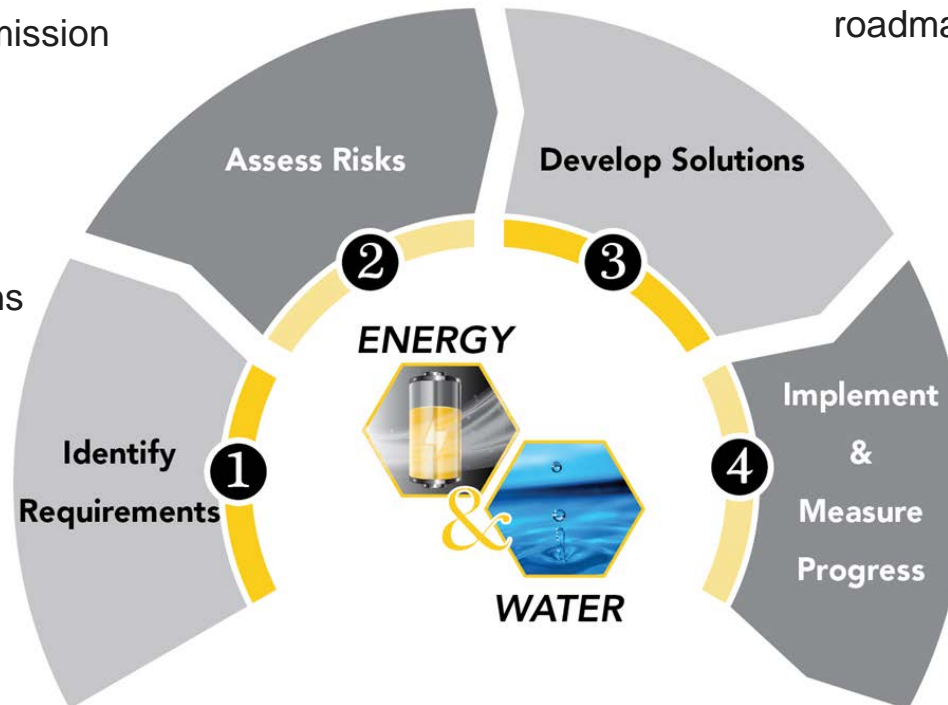
- ▶ **WHEN** you need it
- ▶ **WHERE** you need it
- ▶ **AS LONG AS** you need it

- ▶ Short term 0-3 days
- ▶ Mid term-3 -14 days
- ▶ Long term >14 days

Resilient Energy Solutions Planning & Execution

- ▶ Identify threats
- ▶ Assess likelihood of occurrence
- ▶ Identify infrastructure vulnerability
- ▶ Determine impact to mission
- ▶ Prioritize risks based on mission impact

- ▶ Identify critical missions
- ▶ Identify required utility services
- ▶ Assess associated infrastructure
- ▶ Determine personnel requirements and identify current plans



- ▶ Outline operational tactics
- ▶ Develop project concepts
- ▶ Develop implementation roadmap

- ▶ Secure and execute funding
- ▶ Implement operational tactics and project concepts
- ▶ Measure solution impact
- ▶ Monitor progress of roadmap



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