Headquarters U.S. Air Force

Integrity - Service - Excellence

U.S. Air Force Installation Energy

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Key Takeaways Up Front

- Looking first-and-foremost at energy projects designed to improve mission resiliency
- Examining energy and water vulnerabilities to mission
- Coordinating activities across multiple organizations to enhance mission assurance through energy assurance
- Integrating reliable, resilient, cost-effective energy initiatives to ensure power is available when and where the warfighters need it

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Problem Statement

- If mission resilience is important…
  1. How do we measure it?
  2. How do we decide what actions to take to improve it?
  3. How do we know if our actions made a difference?

- We need solutions that are…
  1. Affordable
  2. Quick to implement
  3. Flexible… can test multiple scenarios
  4. As real as possible without impacting mission
  5. Challenging… challenge assumptions, challenge paradigms

Extensive, Connected Missions

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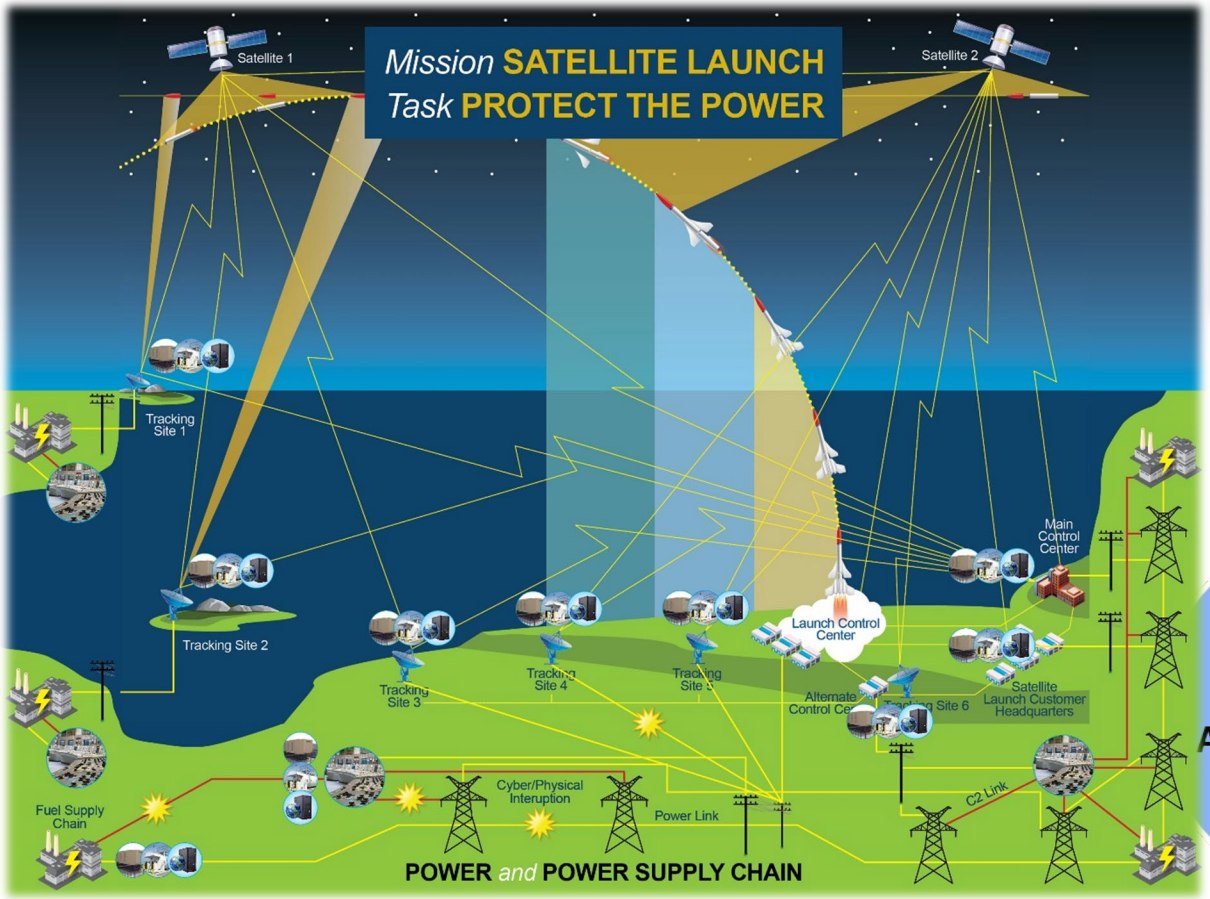
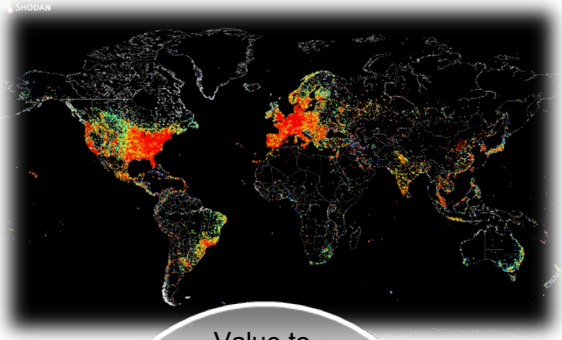


Shodan Map of the Internet



Need to protect the power to project the power

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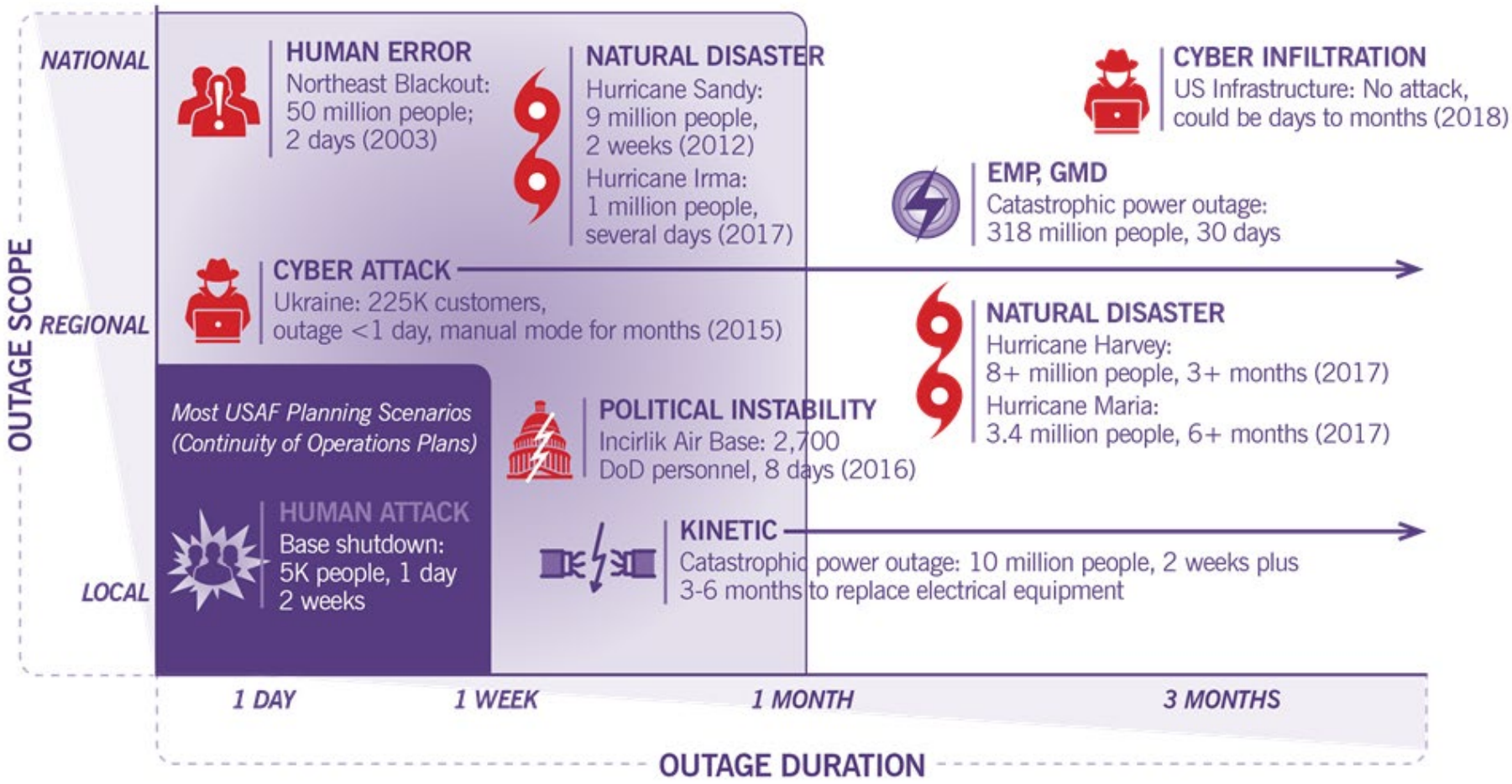
Denial of Service



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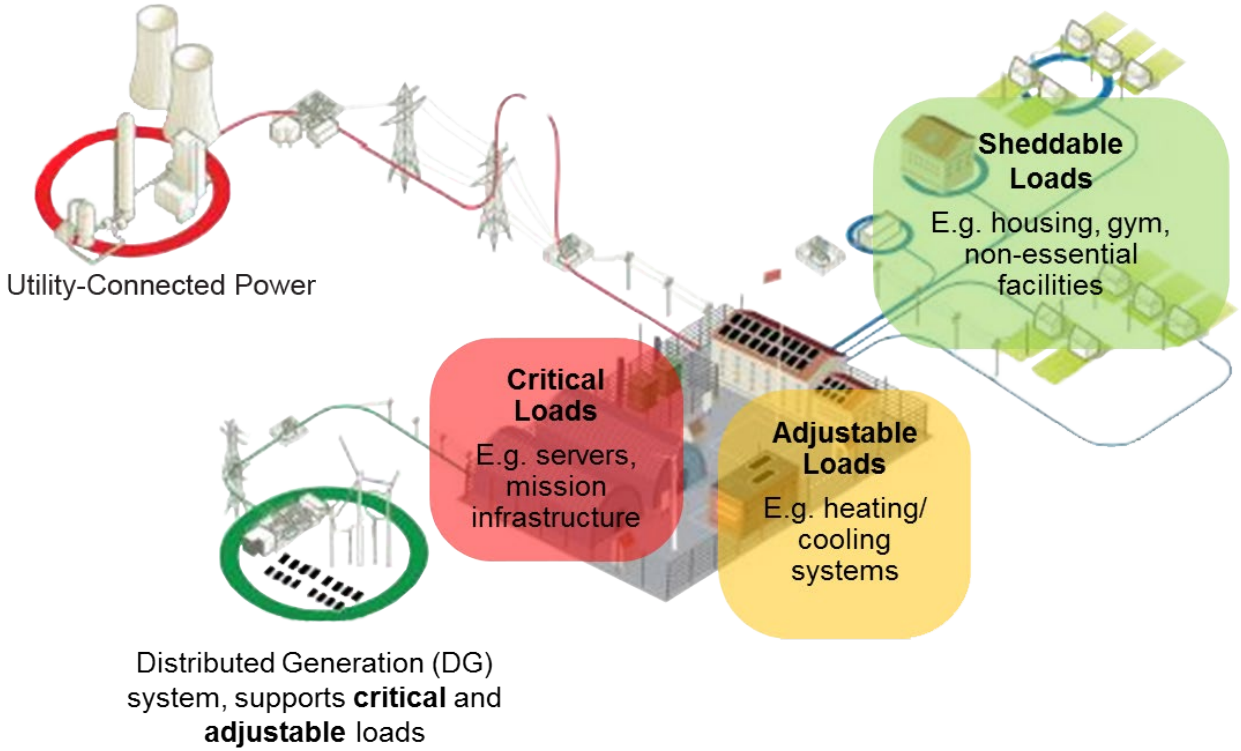
Secure, reliable power to mission-critical infrastructure



DG Value Stream

- Power purchase agreement sales
- Ancillary services
- Capacity market auctions
- Potential resiliency payments from microgrid participants
- Demand response
- Capital cost incentives/grants

By aligning and focusing existing authorities and resources, we will provide new architectures for Air Force installations

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Resilience 5Rs

DEFINITION

Energy Resilience is the ability to prepare for and recover from energy disruptions that impact mission assurance on military installations

ATTRIBUTES

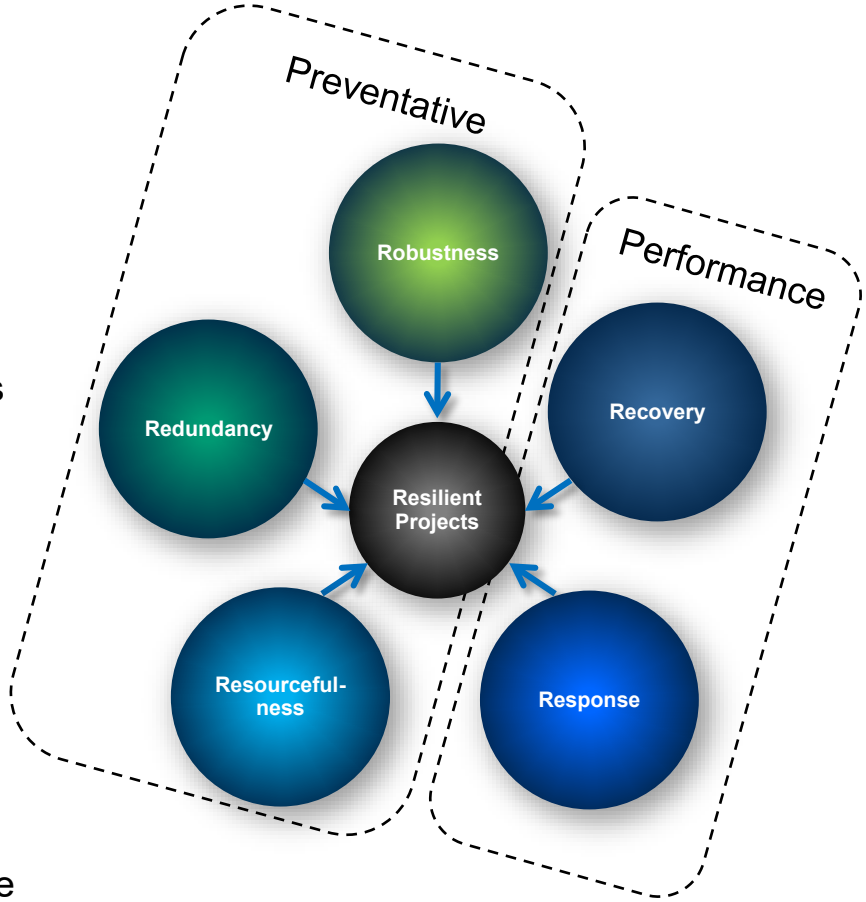
The Air Force utilizes five key resilience attributes to prioritize energy projects and ensure targeted enabling system investments are effective in supporting mission needs

CHALLENGE

Resilience is a multi-time dimensional concept, the nexus where preparation meets performance - this is difficult to measure and assess with existing project metrics

WAY FORWARD

Utilize attributes to assess projects and make smarter investments towards more resilient installations



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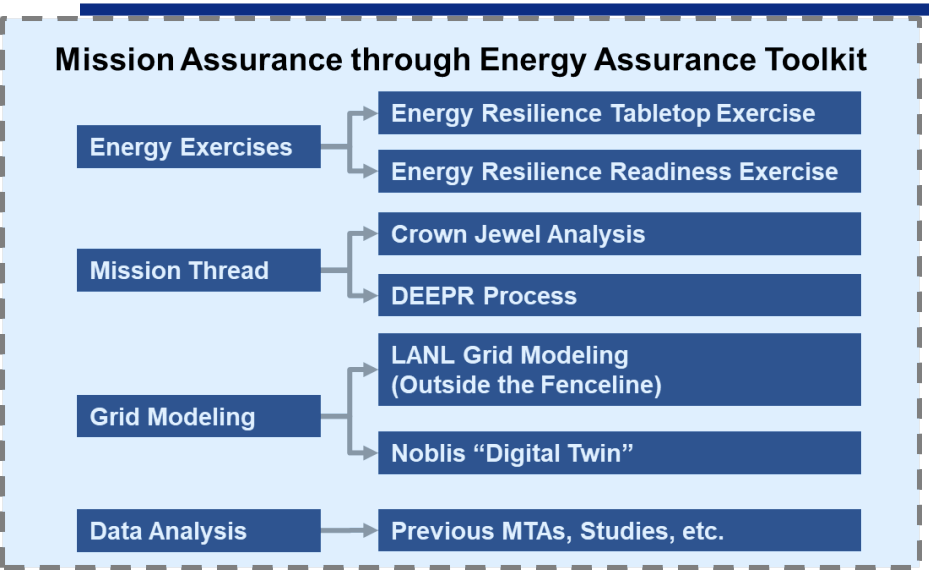
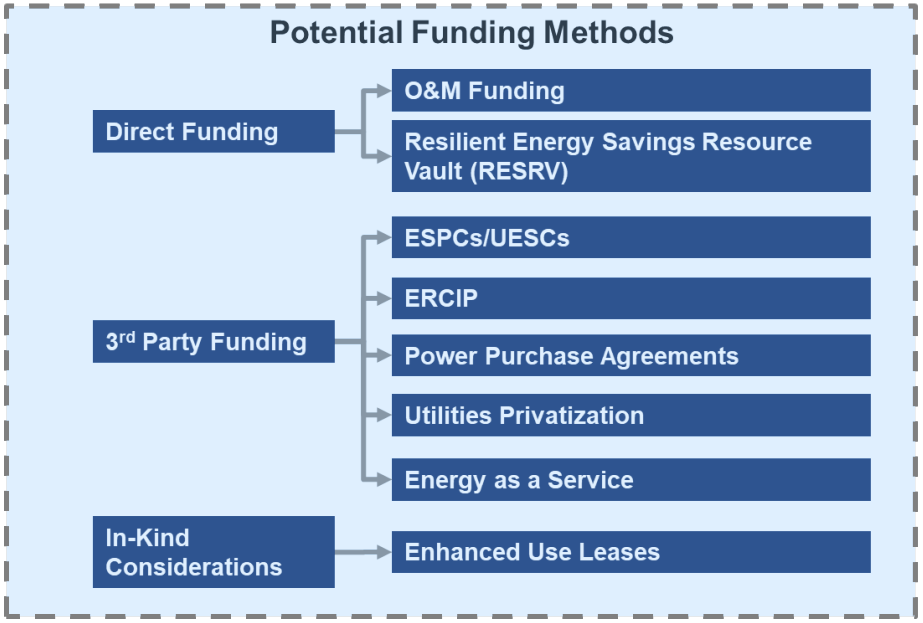
Next Steps, Integration



The full suite of Mission Assurance through Energy Assurance exercises, modeling, and programmatic support will enhance the resilience of missions aboard the installation and close identified gaps

Installation Energy Plans



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Overview of Mission Thread Analysis (MTA)

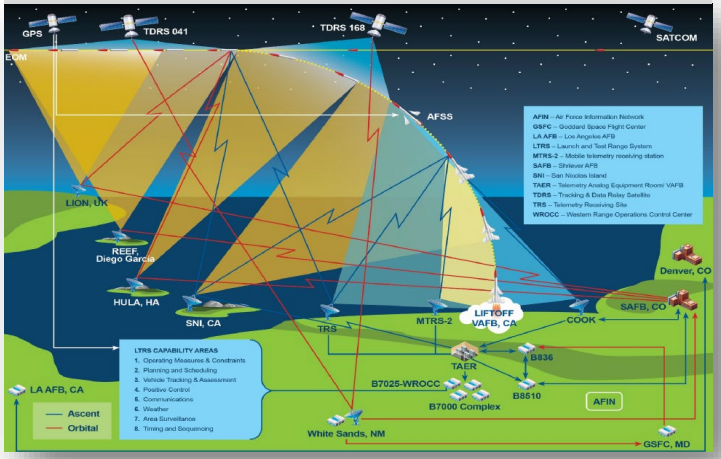
MTA Purpose: Indicate where targeted investments in energy systems may most effectively advance mission readiness through energy resilience.

Research and Scoping → Mission Needs Analysis → System Modeling → Resilience Analysis → Business Case Analysis → Solution Execution

MTA at VAFB:

- *2017:* Conducted research and scoping of satellite launch mission, used lessons learned to build out MTA process
- *2019*: Conducting MTA system modeling step with Los Alamos National Lab's Severe Contingency Solver; leveraging mission needs analysis outputs from complementary efforts

Operational View of 2017 VAFB mission



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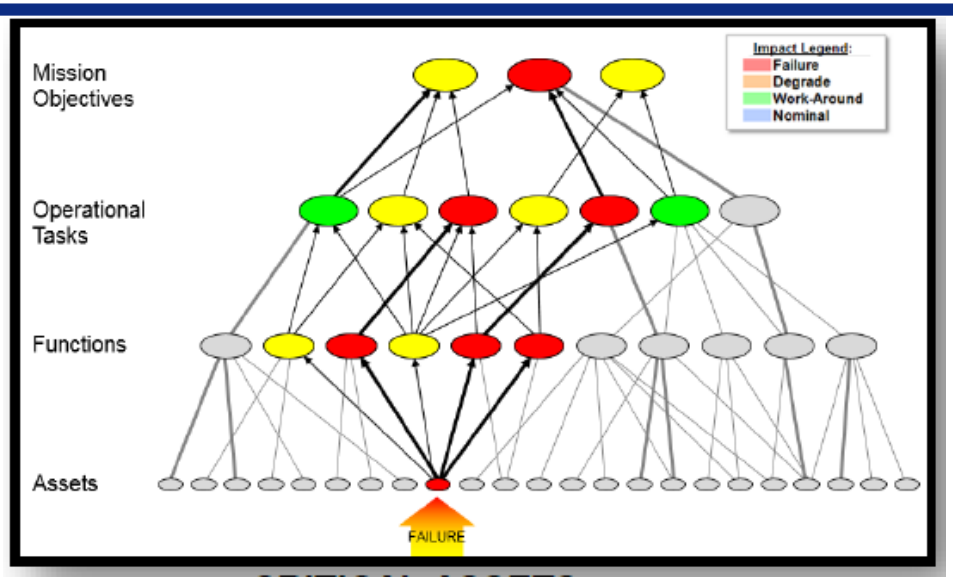
Mission Decomposition

What must be accomplished?

How is it accomplished?

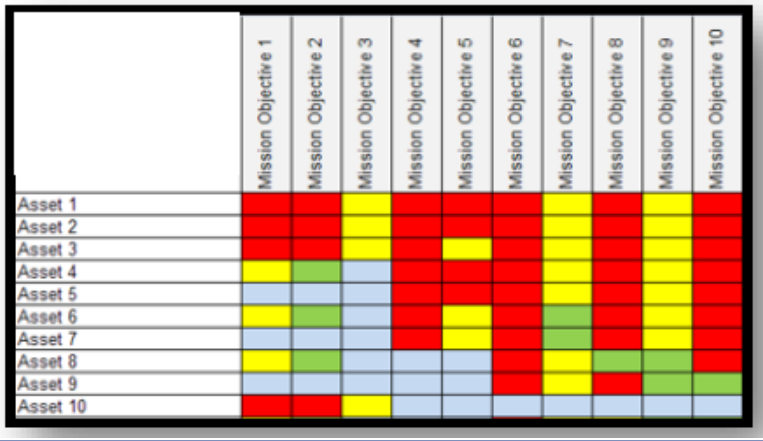


What is its effect here?

If service is denied here…

CRITICAL ASSETS

Mission Impact from Task Anomaly:		Task	1	2	3	4
0 = No Impact on Achievement		Task Rel Wt	13.10	13.10	9.66	9.66
30 = Objective Achievable Using Work Around		Task	A1.1 - Maintain Relevant Situation Information	A1.2 - Monitor Enemy Situation	A1.3 - Monitor Friendly Situation	A1.4 - Monitor Own Unit Situation
70 = Objective Degraded Even With Work Around						
95 = Objective Not Achievable at all						
No.	Mission Objective	Obj Rel Wt				
1	A1 - Monitor Situation	0.138	95	95	70	70
2	A2 - Assess Situation	0.138				
3	A3 - Plan Operations	0.172				
4	A4 - Execute Operations	0.276				
5	A5 - Maintain Mission Readiness	0.138				
6	A6 - Protect Mission Systems	0.138				



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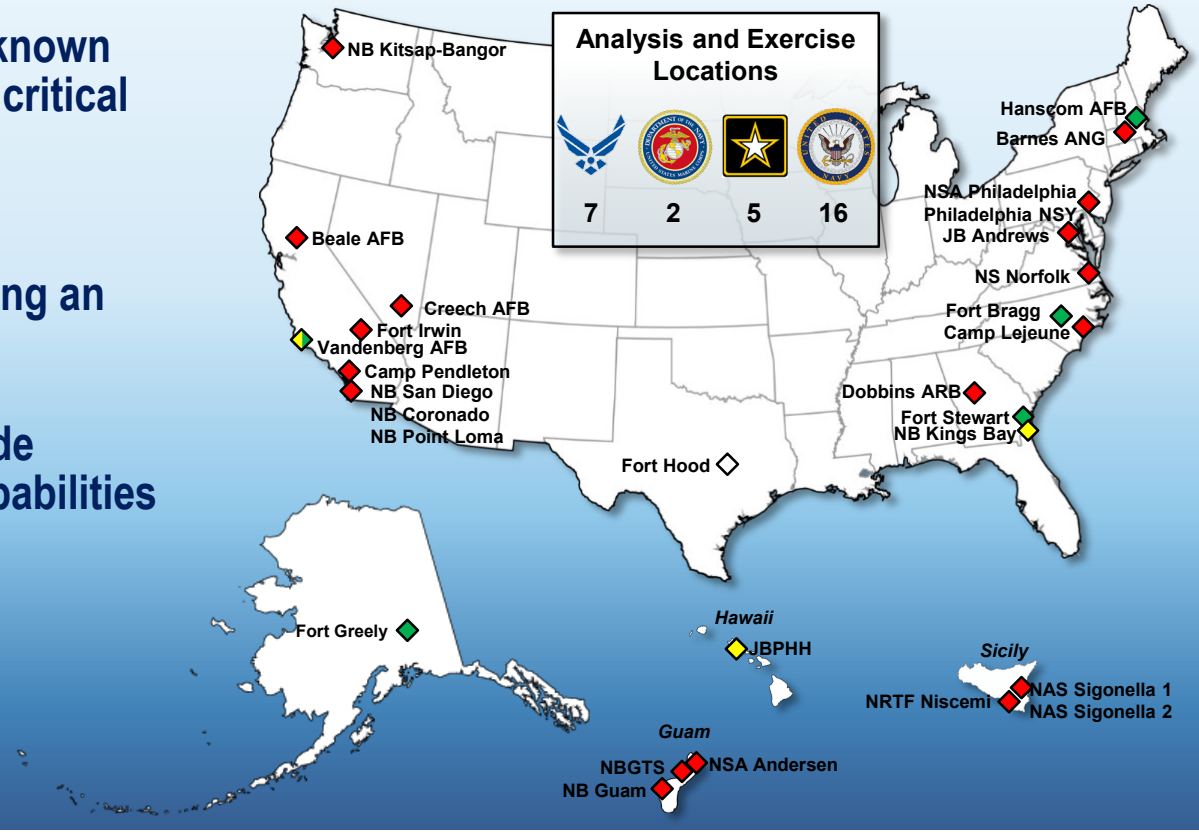
DoD Energy Resilience Conditions

Near-peer adversaries are targeting critical electrical infrastructure
Downstream effects will impact DoD installation power projection
Operational testing ensures mission success during an outage

- Sites currently operate with unknown risks and interdependencies to critical systems and missions
- Tabletop exercises investigate responses and capabilities during an extended simulated outage
- "Pull-the-plug" exercises provide awareness of actual system capabilities during a real outage



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Installation Energy Resiliency Dashboard

INSTALLATION ENERGY RESILIENCY DASHBOARD

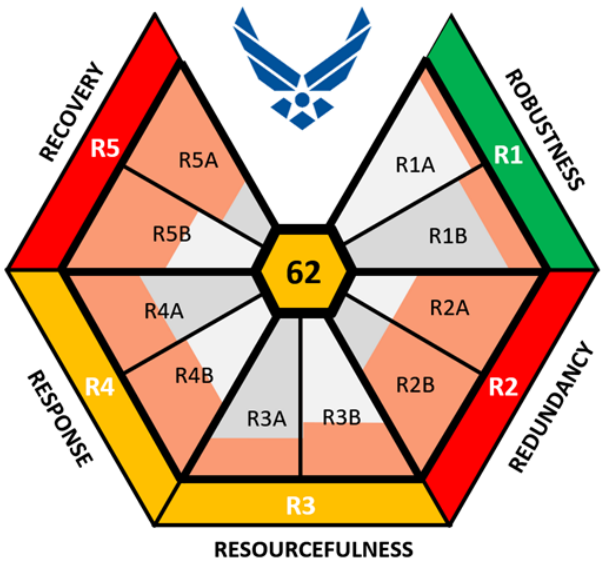
EXAMPLE AIR FORCE INSTALLATION

Existing Conditions

Installation Threat Probability

- Fire
- Cyber-Attack
- Flood
- Hurricane
- Earthquake
- Utility Blackout

Low
Medium
High



Rating Scale

RESILIENT ENERGY + WATER PERFORMANCE

R1 ROBUSTNESS
How robust are the energy+water systems on installation?
R1A Cybersecurity of Energy Systems
R1B Physical Hardening / Protection of Critical Assets

R2 REDUNDANCY
Are there redundant systems and alternate sources to avoid single points of failure?
R2A Single Points of Failure in Energy + Water Systems
R2B Energy & Water Source Diversity

R3 RESOURCEFULNESS
Is energy efficiently managed and delivered?
R3A Energy & Water Intensity (Demand) Reduction
R3B Energy & Water O&M Manpower & Skillsets

R4 RESPONSE
Is the Installation prepared to respond to emergency/disruptive event?
R4A Emergency Management Protocols for Energy+Water Systems
R4B Critical Loads with Island / Backup Mode Operations

R5 RECOVERY
How long can critical mission functions be sustained in emergency mode?
R5A Critical Loads Sustainment Capacity (Fuel/Energy+Water Storage)
R5B Reliability of Emergency Energy & Water Systems & Operations

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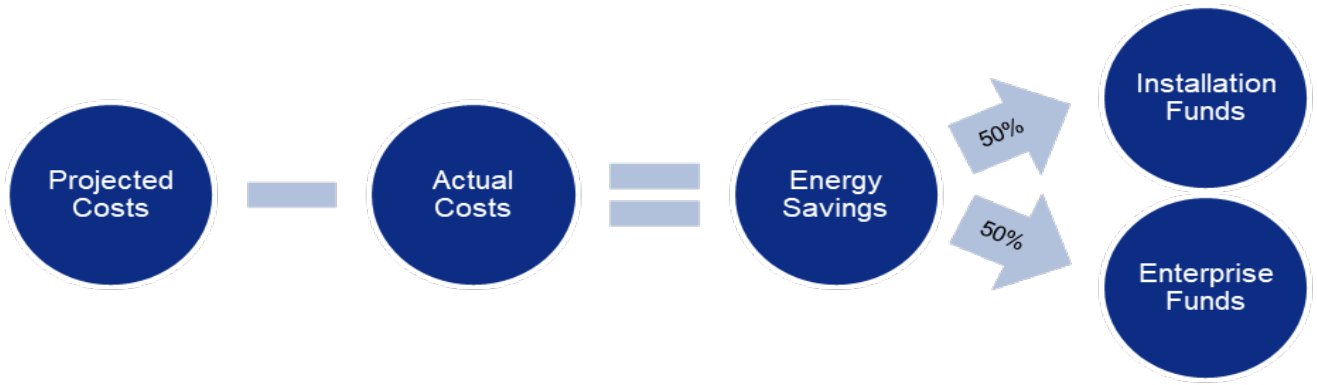
Other Topics of Interest



- **Resilient Energy Savings Resource Vault (RESERV)**
  - **Applying energy savings so one-half goes towards energy resilience, while the other half goes to the installation**
- **Utilities Privatization**
  - **Pursuing UP where the mission needs it, the system demands it, and all parties benefit from it**

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