Pacific Northwest
NATIONAL LABORATORY

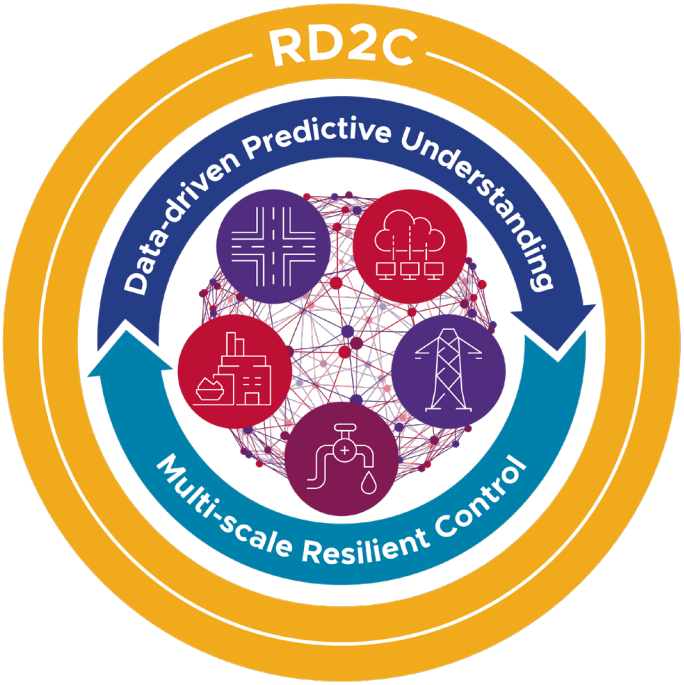
# Resilience through Data-driven, intelligently Designed Control (RD2C)

We're advancing scientific understanding of cyber-physical systems and seeking novel sensing and control approaches that will advance resiliency of our critical infrastructures

Americans rely on critical infrastructures (CIs) to protect the nation, maintain a strong economy, and enhance quality of life. These infrastructures—the electrical power grid, transportation systems, information networks, and more—are evolving and modernizing. They have become increasingly complex, connected, and vulnerable to adverse conditions, such as cyber and physical attacks and faults.

As a result of this complexity and uncertainty, cyber-physical systems (CPSs) that provide sensing and control for CIs need to be more deeply understood and modeled. Control approaches and algorithms need to evolve to intelligently adapt and achieve increased security and resiliency.

The **Resilience through Data-driven, intelligently Designed Control (RD2C) Initiative** was launched in 2021 and seeks to develop resilient and intelligent sensing and adaptive control algorithms through observational understanding and characterization of CPSs under adverse conditions. The initiative, stewarded by Pacific Northwest National Laboratory's National Security Directorate, will create solutions to help enable rapid, intelligent, and adaptive infrastructure control decisions at multiple layers and time scales to increase resiliency.




## RESEARCH APPROACH: INTEGRATED SCIENCE THRUST AREAS

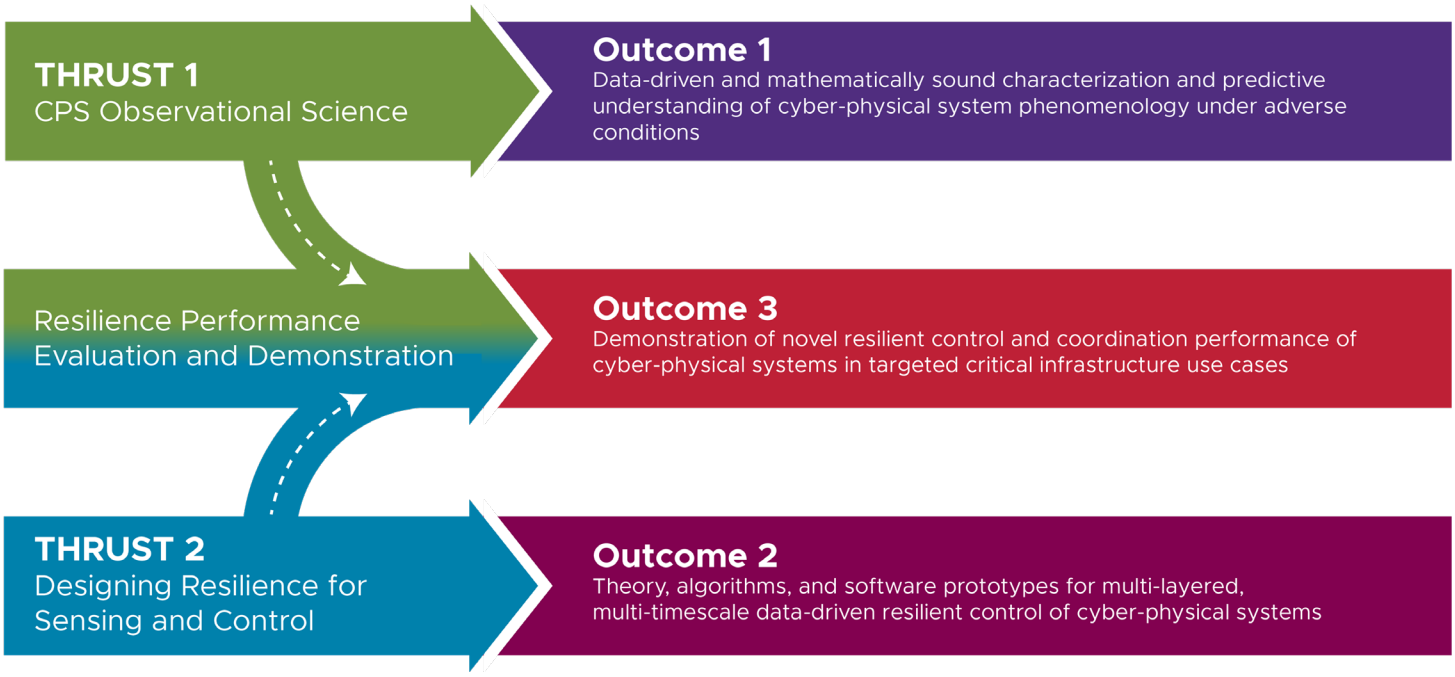
**The initiative pursues two science thrusts:**

**CPS Observational Science** acknowledges that multimodalities and complex interdependencies in CPSs give rise to emergent and ensemble behaviors under adverse conditions that are difficult to observe and characterize in real-world

or demonstrated normal conditions. Through deep understanding of these systems and the data that RD2C's experiments will produce, new theories, approaches, and algorithms for control can be devised.

**Designing Resilience for Sensing and Control** recognizes that current sensing and control solutions need to evolve to meet the need of future CIs. These solutions are not context-aware and are not robust or adaptive enough to assure resilience under adverse conditions in increasingly complex applications for future CIs.

Both thrusts contribute to a third outcome focused on resilience performance to demonstrate novel resilient control and coordination performance of CPSs in targeted critical infrastructure use cases.




**RD2C Initiative thrusts, outcomes, and integration**

## ABOUT PNNL

Pacific Northwest National Laboratory advances the frontiers of knowledge, taking on some of the world's greatest science and technology challenges. Distinctive strengths in chemistry, Earth sciences, biology, and data science are central to our scientific discovery mission. PNNL's research lays a foundation for innovations that advance sustainable energy through decarbonization and energy storage and enhance national security through nuclear materials and threat analyses.

## CONTACT

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