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ROCKEFELLER RESILIENCE CHALLENGE

100 Resilient Cities Challenge

PROVIDING TECHNICAL EXPERTISE TO
HELP CITIES
BETTER ADDRESS THE INCREASING SHOCKS AND STRESSES
OF THE 21ST CENTURY.

Sandia National Laboratories

U.S. DEPARTMENT OF
ENERGY

N S A
National Nuclear Security Administration

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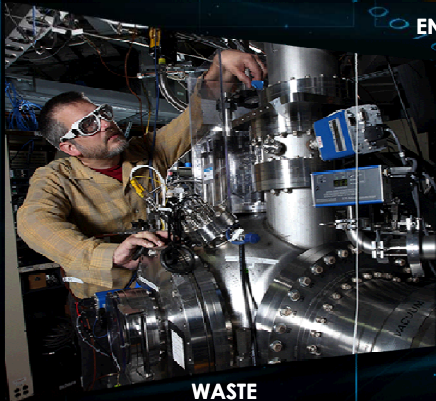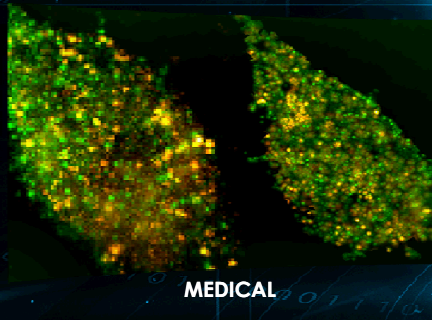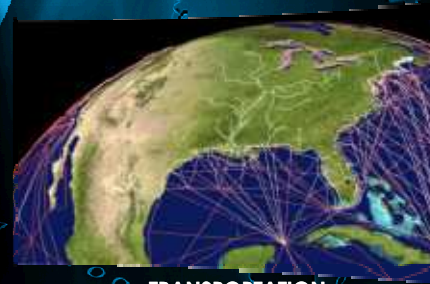OF THE 21ST CENTURY.

ENERGY

RISK ANALYSIS

WATER

WASTE

MEDICAL

TRANSPORTATION

FOOD

EMERGENCY
RESPONSE

ECONOMY

PSYCHOLOGICAL /
COGNITIVE EFFECTS

THE ROCKEFELLER FOUNDATION
100 RESILIENT CITIES
CENTENNIAL CHALLENGE

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Sandia mirrors concentrate a large amount of sunlight onto a small area; electrical power is produced when the light is converted to heat that drives a generator.

ENERGYCHALLENGE

Energy systems are critical to the basic functioning of a city, both during disruptive events and for long-term growth.

Energy systems designed for resilience can both withstand disruptive events and provide sustainable, affordable power.

Cities must evaluate their existing power grid and identify the resilience improvements that can be made given available resources.

Using its engineering expertise in renewable energy systems, power engineering, and risk and resilience analysis, Sandia can help cities determine resilience-enhancing energy system options, based on the cities' available resources. Sandia can design innovative systems that in the event of a disaster can prioritize which critical functions receive power as it becomes available.

For example, Sandia's **Energy Surety Microgrid™** increases city resilience by allowing it to generate and control electrical power in self-contained, localized areas. This ensures that if the main power grid is disrupted, essential infrastructure, such as buildings, transportation, and medical facilities, have the power necessary to maintain life-saving functionality.
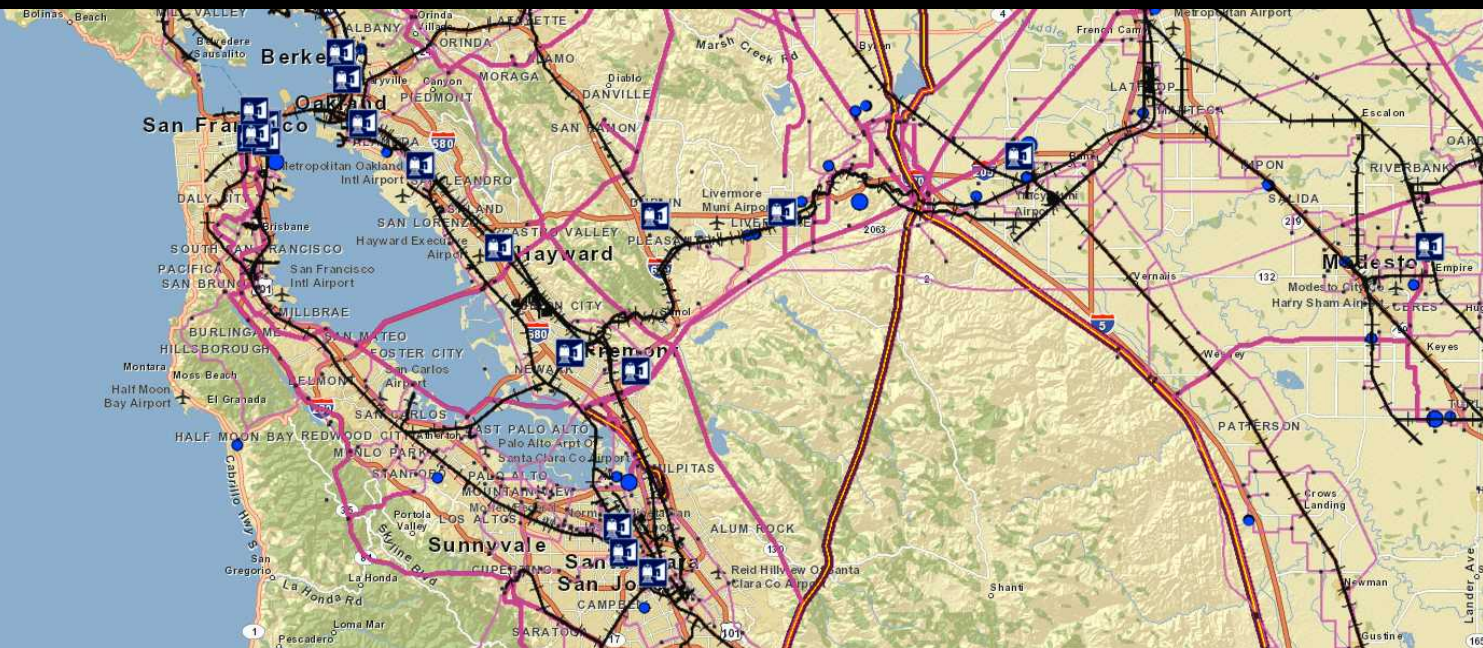
Sandia combines GIS data with infrastructure models to assess the vulnerabilities and other risks to cities of natural and man-made disasters.

RISK ANALYSIS CHALLENGE

Identifying goals and priorities across a diverse set of risks and competing demands can be challenging for city officials.

Risk analysis presents cities with the opportunity to rigorously explore all hazards and generate useful data to inform decisions and move toward resilience.

Sandia is a world leader in all-hazard risk analysis. Sandia's experience in evaluating threats (such as hurricanes, flooding, drought, and terrorist attack), vulnerabilities, and consequences, coupled with expertise in critical infrastructure, can significantly enhance a city's resilience.

Sandia also has substantial experience in designing and facilitating table-top exercises with government officials to determine optimal risk mitigation strategies.

Sandia scientist treats brackish water for human consumption.

WATERCHALLENGE

1.6 billion people, or almost one quarter of the world's population, face water shortage.

2.6 billion people lack access to adequate sanitation.

Cities must ensure a safe and sufficient water supply to their citizens and for future generations.

Sandia pioneered the field water infrastructure risk analysis based on its comprehensive expertise in geological and urban water systems. Sandia specializes in helping cities determine which efforts will be effective in reducing their water risks and increasing their resilience.

Areas that can provide enormous cost-saving benefits for cities include reducing the amount of water used in energy production and innovative education campaigns targeted at changing consumer behavior.

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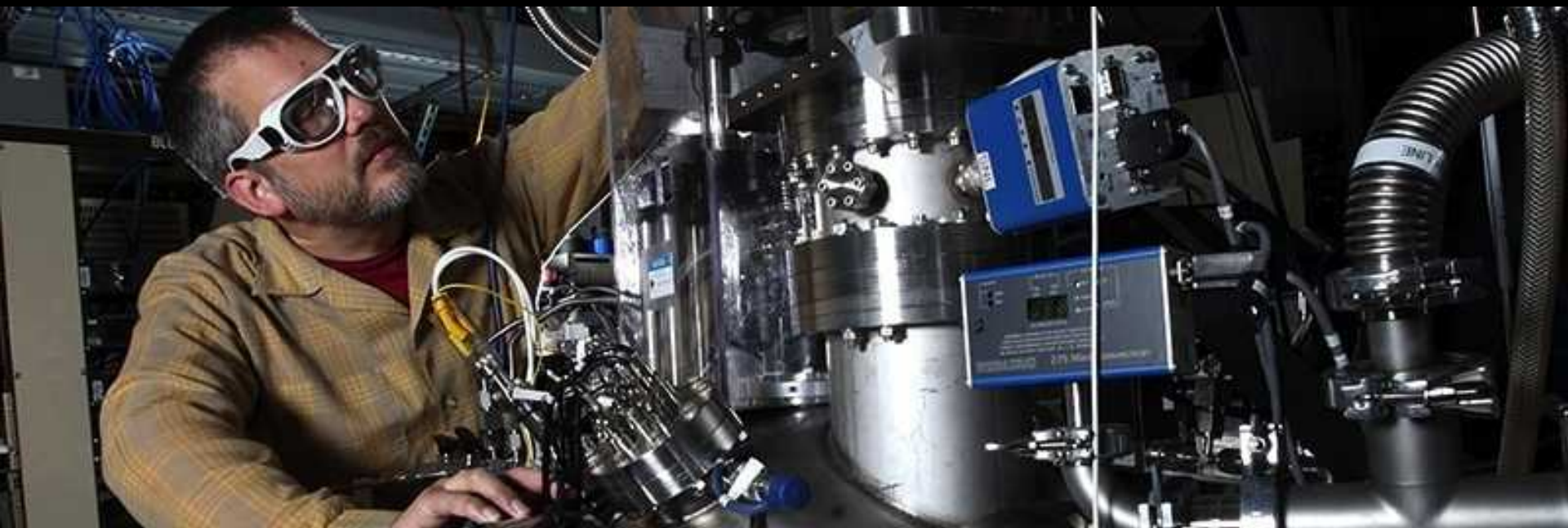
Sandia has collaborated on techniques for monitoring molecules that break down sulfur dioxide and nitrogen dioxide in the air, which may help offset global warming.
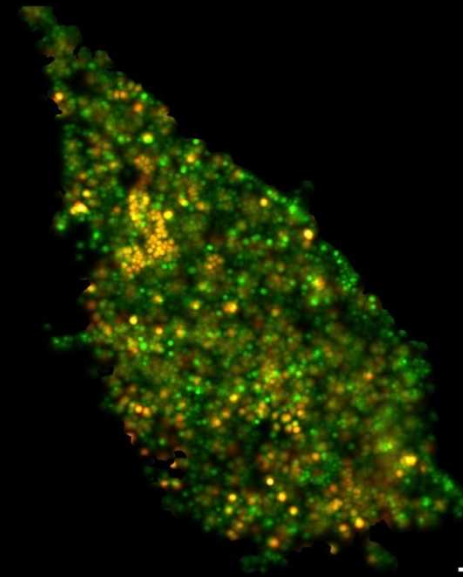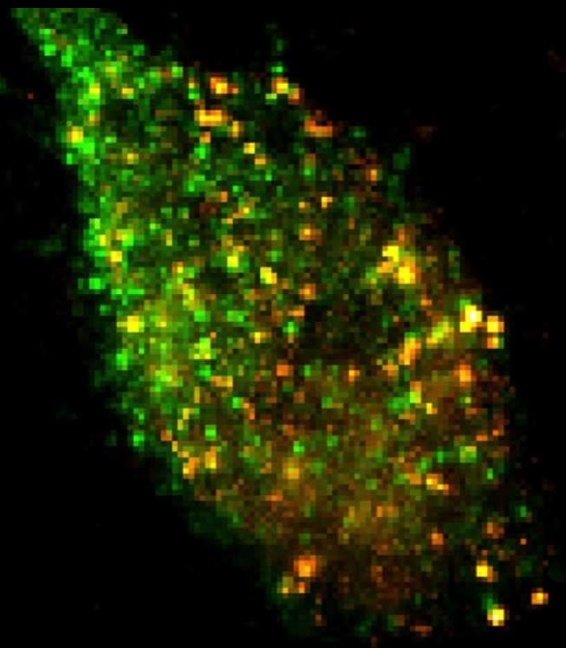
WASTECHALLENGE

Cities face significant challenges with landfills and the accumulation of waste, which can contaminate water and soil, emit greenhouse gasses, and pose health risks to citizens and animals.

As cities grow larger, landfills are moved further away resulting in increased waste disposal costs.

Cities must develop cost effective and sustainable means for processing waste.

Sandia develops and applies innovative engineering techniques to reduce the amount of waste as well as its harmful and costly side effects.

For example, Sandia can help cities implement multiple resilience strategies to achieve zero-waste-to-landfill goals. A city's goal may include converting municipal solid waste to electricity and transportation fuel.

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Sandia unlocks important secrets of plagues and other biological threats to humans.

MEDICALCHALLENGE

Disasters both increase demands for medical services and obstruct the delivery of materials and services to hospitals.

Cities must develop plans that identify critical medical resources and processes to ensure their availability in times of crisis.

Sandia has developed a suite of medical supply chain models that help hospitals more effectively provide medical services when electric power, water, and communications infrastructure are lost.

Sandia also has extensive expertise in modeling the spread of contagious diseases in urban populations and estimating their impacts on the local economy and infrastructure.

Sandia has developed innovate multi-modal transportation tools for assessing transportation risks at the city, regional, national, and international levels.

TRANSPORTATIONCHALLENGE

Traffic and transportation systems are extremely complicated and dynamic networks; analyzing and planning resilience across multiple modes of transportation compounds the complexity.

City transportation resilience plans help ensure long-term sustainability as populations grow.

Sandia has extensive experience helping cities create redundant and resilient transportation systems. Such systems ensure operation of essential response functions, such as evacuation, access to hospitals and emergency responders, and restoration of critical infrastructure, during disruptive events.

Sandia can also help cities identify and address points in the transportation system that are vulnerable not only to damage but also to congestion and inefficiencies in an emergency.

Sandia simulations and analysis can generate probability maps that help determine where food contamination started in a contaminated food system.

FOODCHALLENGE

Cities are challenged with providing adequate and nutritious food to their citizens, especially their most vulnerable populations.

Cities must ensure the availability and safety of food during and after disasters.

As populations grow, cities must establish healthy and reliable food supplies for future generations.

Sandia has comprehensive expertise in improving the resilience of food supply chains for cities, regions, and countries. Sandia uses proprietary modeling and simulation tools to identify and mitigate potential disruptions to a city's food system. These methods were recently used to lessen the negative effects of Superstorm Sandy on New York City's food supply.

Sandia can also help cities develop strategies to increase the amount of food produced in close proximity to urban areas.

Sandia teams of infrastructure modelers and analysts provide crisis response to real-time disasters.

EMERGENCY RESPONSE CHALLENGE

The actions taken by cities in the immediate aftermath of a disaster have long-term effects on the well-being and resiliency of their citizens and critical infrastructure.

The restoration of critical infrastructure, such as access to roads, power, and water, as well as neighborhoods and specific functions, must be prioritized.

Sandia has vast amounts of experience in helping cities design effective emergency response plans and processes. In the event of a disaster, these plans reduce negative impacts to citizens and minimize the downtime of critical buildings, utilities, and infrastructure. For example, Sandia is one of the world's leaders in designing evacuation plans for cities using its state-of-the-art optimization models.

Sandia also has extensive experience in designing and executing table-top exercises that test emergency response plans at the city and national levels. Sandia can help cities design, plan, and run exercises that give them insight into their preparedness.
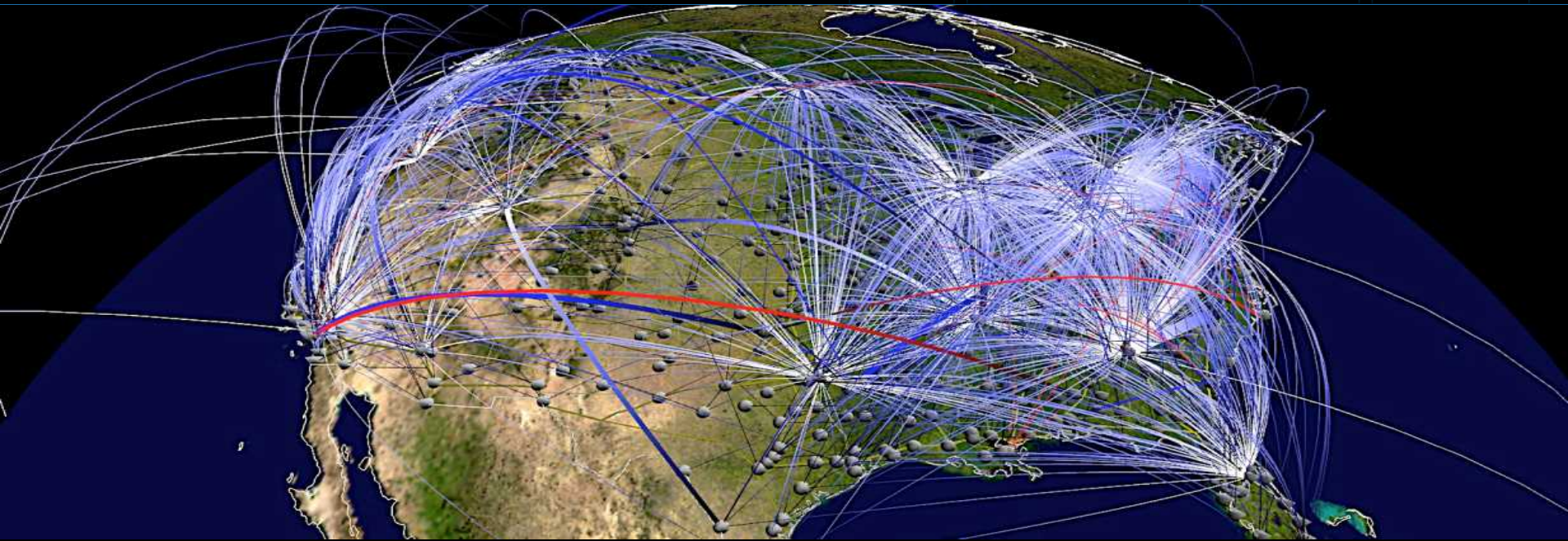
Sandia's N-ABLE™ agent-based tool models complex economic and critical-infrastructure impacts and interdependencies at the city to international scales.

ECONOMYCHALLENGE

Natural and man-made disasters can significantly impact a city's economy through disruptions to businesses and damage to the homes of its citizens.

Economic impact analyses help cities understand which regions and sectors of their local economy are most vulnerable to disasters, and what can be done to mitigate, if not prevent, these impacts.

Sandia has conducted well over 100 detailed economic analyses of man-made and natural disasters. Using best-of-class, long-run macroeconomic models, Sandia has substantial experience developing infrastructure investment strategies to help jurisdictions maximize their potential for an economically competitive and resilient future.

Research at Sandia has shown that it's possible to predict how well people will remember information by monitoring their brain activity while they study.

PSYCHOLOGICAL/COGNITIVE EFFECTSCHALLENGE

Citizens may have difficulty rebounding from traumatic shocks such as droughts, famines, floods, and regional conflicts.

Cities that understand how their citizens are likely to react during an traumatic event can develop plans that can mitigate harmful behaviors.

Sandia's advanced behavioral modeling and simulation tools have been used to predict and mitigate impacts to people after traumatic events.

For example, Sandia has developed models that simulate cognitive processes people use to make decisions and express behaviors during extreme events. Sandia has also developed the Human Resilience Index that can help cities identify parts of their population that are at risk for acute distress following a disaster.

Sandia National Laboratories is a non-profit organization recognized as a global leader in modeling and analysis of resilient systems and societies. In support of Rockefeller's Centennial Resilient Cities Challenge, Sandia has developed a comprehensive toolkit of infrastructure, economic, and societal models that can help local leaders better assess their specific resilience challenges and select the most cost-effective ways to address them. Sandia's breadth of expertise in nearly every type of critical infrastructure, paired with strong partnerships with world-renowned collaborators, can provide Chief Resilience Officers with access to a unique and comprehensive suite of capabilities.

Sandia's unique value stems from decades of experience analyzing the nation's critical infrastructure systems' risks of and resilience to man-made and natural disasters. Sandia understands when and how these systems are dependent on and interdependent with each other, for example, how energy systems are interdependent with water systems. This experience and understanding helps determine when to use state-of-practice or state-of-the-art risk and resilience techniques. Furthermore, having been technical experts in many city and regional disaster planning exercises, Sandia understands how to work with local leaders to understand their city's unique risks and how to develop plans for increasing city resilience through improvements to their infrastructure, economic, and societal systems.

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Charles Rath
crrath@sandia.gov
505.844.9902

Mark Ehlen
maehlen@sandia.gov
505.284.4568

Sandia National Laboratories, NM
P.O. Box 5800
Albuquerque, NM 87185-1137

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