

ADAPTATION AND RESILIENCE IN THE TRANSPORT, BUILDINGS, AND ENERGY SECTORS

Who Is Adapting?

- Energy utilities and some regulators
- Transport networks and regulators
- Construction industry (associations, manufacturers, installers, surveyors, engineers)
- Governments: Local, regional, and national
- EU level: EU institutions, investment banks

Why Are They Adapting?

- **Costs of non-action:** **\$3.8 billion/year** of damages to critical infrastructures and key investments in energy in transport, industry, and social sectors due to climate extremes in Europe¹
- **Benefits of adaptation:** Estimated **\$113 billion** vs. costs of **\$44 billion** up to 2040 in Europe (cumulative)¹
- Legislation and land-use planning
- Changes in industry standards

What Are the Most Common Adaptation Measures?

- **Engineering solutions:** Infrastructure strengthening and increasing capacity
- **Knowledge transfer actions:** Awareness-raising, surveys, and training
- **Operational measures:** Integration into standards, maintenance regimes
- **Ecosystem-based Adaptation (EbA):** E.g., nature-based water management solutions

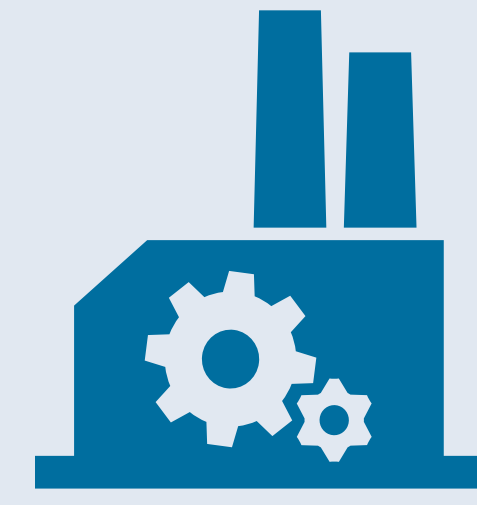
Rebuilding Critical Infrastructure in Puerto Rico

Following the 2017 hurricanes, Navigant is advising on Puerto Rico's power and grid rebuild. We manage the implementation and have:

- Assessed the damage
- Described the new system design
- Engaged stakeholders
- Proposed rebuild roadmap
- Defined first level funding requirements
- Established the Project Management Office (PMO)

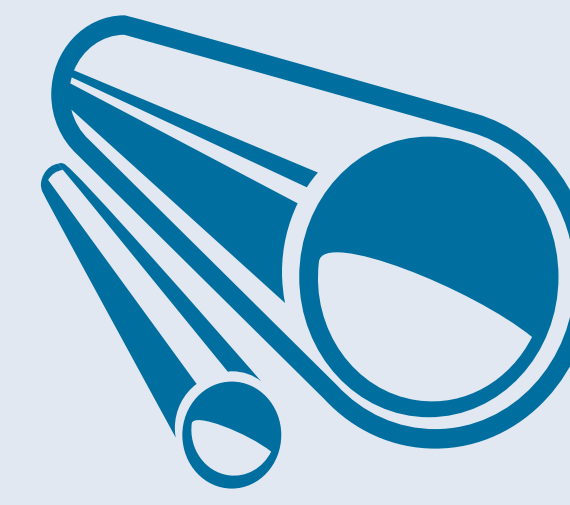
What Are the Climate Impacts?

Energy²



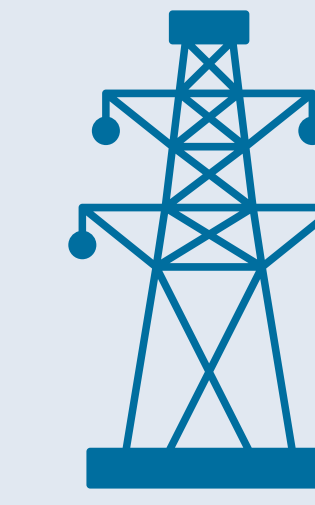
POWER STATIONS

Thermal power plants affected by the decreasing efficiency of thermal conversion. Reduced water for cooling and increasing water temperatures could lead to reduced power operations.



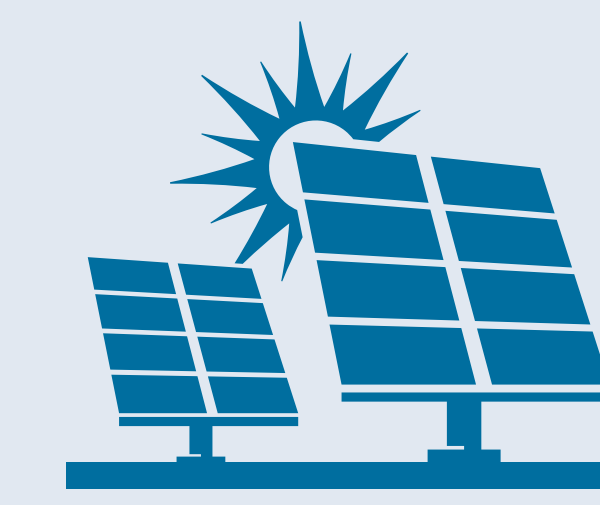
PIPELINES

Oil and gas pipelines in coastal areas affected by rising sea levels and those in cold climates by thawing permafrost. May require new land zoning codes, standards, and structural upgrades to infrastructure.



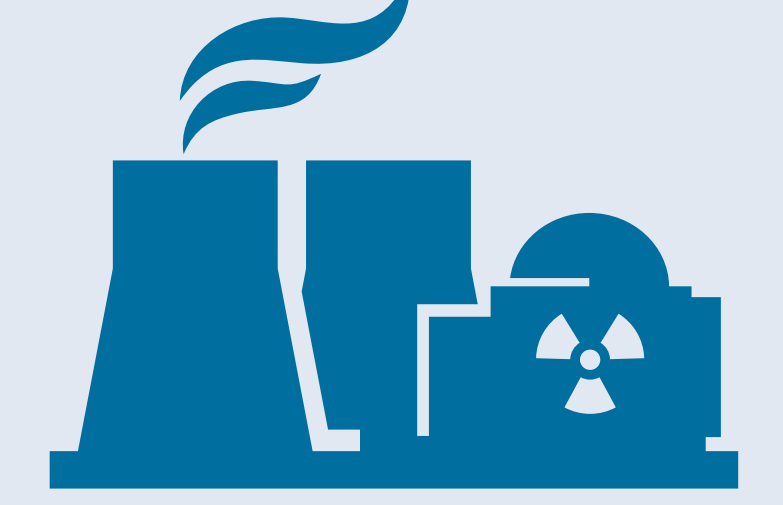
POWER LINES

Extreme weather events could damage power lines. Standards can be amended for appropriate adaptation measures, including re-routing lines away from high-risk areas.



RENEWABLES

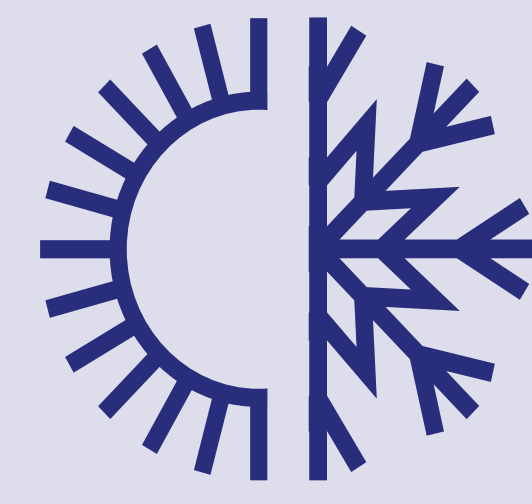
Weather pattern changes threaten to impact the hydrologic cycle underpinning hydropower. Increased cloudiness could affect solar technologies, and increased storms could damage equipment.



NUCLEAR

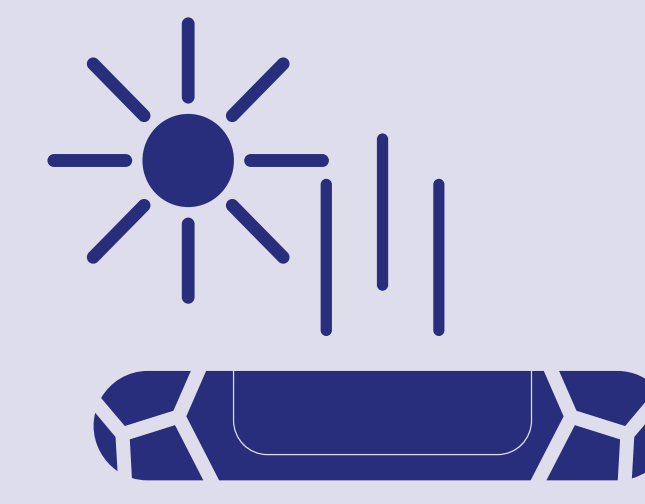
Lack of water and extreme weather events may threaten nuclear plants by disrupting the functioning of critical equipment and processes.

Buildings



THERMAL COMFORT

Keeping buildings and external spaces cooler or warmer will be increasingly required. Urban heat island (UHI) effect is exacerbated with increasing temperatures.



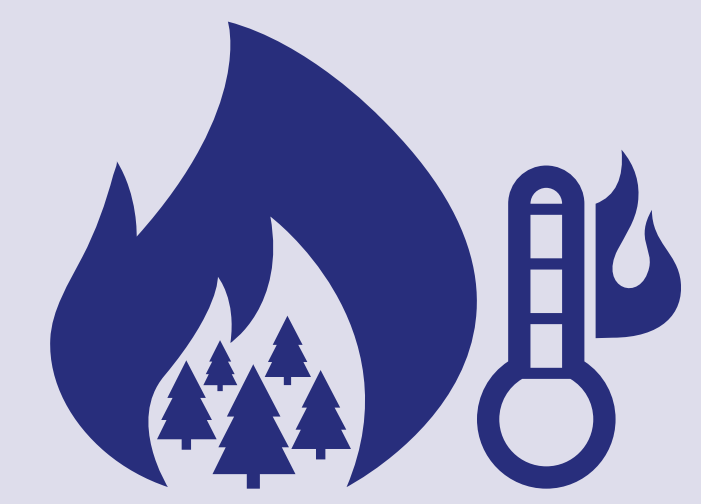
STRUCTURAL STABILITY

Structural stability will change below and above ground due to water scarcity and flooding.



CRITICAL INFRASTRUCTURE

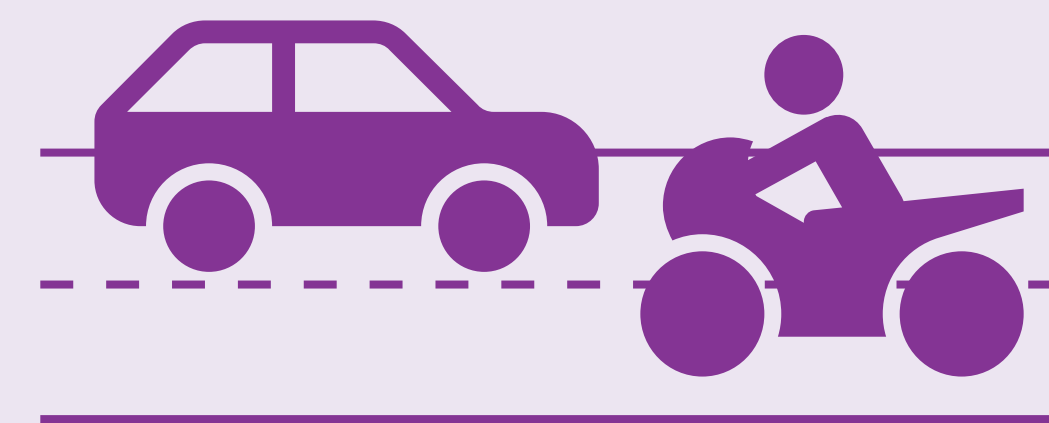
Identifying and classifying buildings whose continuing use is essential to the population for security and safety, and that need to remain operational, will become increasingly important.



FOREST FIRE RISK

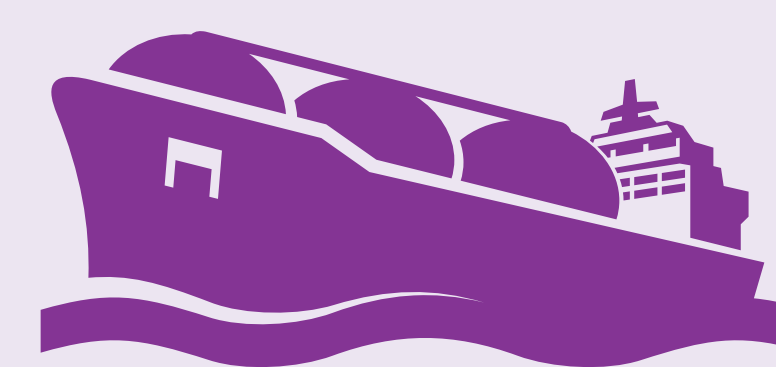
Increased risk of forest fires with rising temperatures, changing precipitation patterns, and droughts.

Transportation



AREAS OF HIGHLY CENTRALIZED TRAFFIC PATTERNS

Small number of hubs can exacerbate vulnerability; the market for just-in-time services drives increasing centralization, making these systems particularly vulnerable.



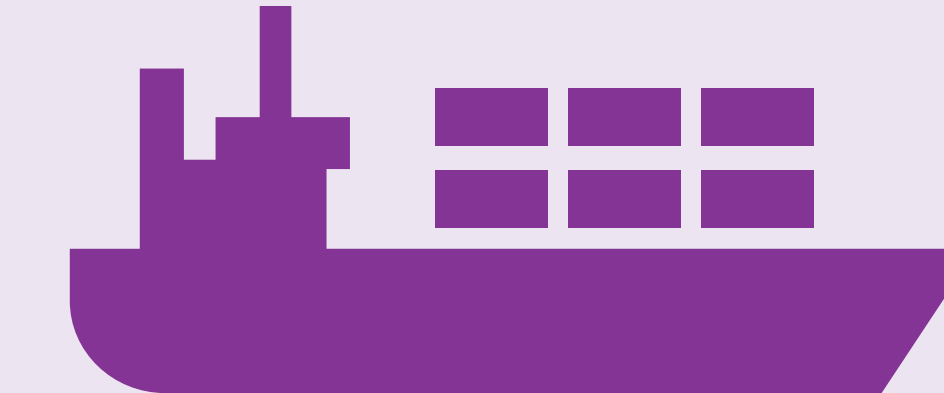
INLAND WATERWAYS

Some international waterways are already drought sensitive. Reduced water levels will not offer sufficient drought protection.



ROAD/RAIL

In mountainous regions, transport networks could be at increasing risk for avalanches and landslides due to intense precipitation events.



PORTS

Vulnerable to sea-level rise and related coastal flooding, storm surges, and increased wave action.



AIR

Sea-level rise, coastal flooding, extreme weather events, and increasing temperatures will contribute to the disruption of services. The disruption from these impacts will be further exacerbated as free capacity will be increasingly occupied by additional flights.

Top 3 Adaptation Actions Discussed by Sector

Energy



- Awareness-raising
- Dam, coastal, river defense
- Integrating adaptation into maintenance regimes and other plans

Buildings



- EbA: water management with green elements
- Building material selection
- Awareness-raising and integrating adaptation into maintenance regimes and other plans

Transportation



- Dam, coastal, river defense
- Infrastructure strengthening
- Integrating adaptation into maintenance regimes and other plans

Reference

¹ Sarah Hendel-Blackford, Kristen Brand, Sam Nierop, Rob Winkel (2017) Assessing Adaptation Knowledge in Europe: Infrastructure Resilience in the Transport, Energy and Construction Sectors. Final Report to the European Commission, DG CLIMA, Project Number DESNLI6057
² European Climate Foundation, the World Energy Council, and the University of Cambridge's Judge Business School and Institute for Sustainability Leadership (2014) Climate Change: Implications for the Energy Sector.