

## Why GAO Did This Study

According to the NRC and the USGCRP, changes in the earth's climate—including higher temperatures, changes in precipitation, rising sea levels, and increases in the severity and frequency of severe weather events—are under way and expected to grow more severe over time. These impacts present significant risks to the nation's energy infrastructure.

Economic losses arising from weather-related events—including floods, droughts, and storms—have been large and are increasing, according to USGCRP. Adaptation—an adjustment to natural or human systems in response to actual or expected climate change—is a risk-management strategy to help protect vulnerable sectors and communities that might be affected by climate change.

GAO was asked to examine the vulnerability of the nation's energy infrastructure to climate change impacts. This report examines: (1) what is known about potential impacts of climate change on U.S. energy infrastructure; (2) measures that can reduce climate-related risks and adapt energy infrastructure to climate change; and (3) the role of the federal government in adapting energy infrastructure and adaptation steps selected federal entities have taken. GAO reviewed climate change assessments; analyzed relevant studies and agency documents; and interviewed federal agency officials and industry stakeholders, including energy companies at four sites that have implemented adaptive measures.

View [GAO-14-74](#). For more information, contact Frank Rusco at (202) 512-3841 or [ruscof@gao.gov](mailto:ruscof@gao.gov).

## CLIMATE CHANGE

### Energy Infrastructure Risks and Adaptation Efforts

## What GAO Found

According to assessments by the National Research Council (NRC) and the U.S. Global Change Research Program (USGCRP), U.S. energy infrastructure is increasingly vulnerable to a range of climate change impacts—particularly infrastructure in areas prone to severe weather and water shortages. Climate changes are projected to affect infrastructure throughout all major stages of the energy supply chain, thereby increasing the risk of disruptions. For example:

- *Resource extraction and processing infrastructure*, including oil and natural gas platforms, refineries, and processing plants, is often located near the coast, making it vulnerable to severe weather and sea level rise.
- *Fuel transportation and storage infrastructure*, including pipelines, barges, railways and storage tanks, is susceptible to damage from severe weather, melting permafrost, and increased precipitation.
- *Electricity generation infrastructure*, such as power plants, is vulnerable to severe weather or water shortages, which can interrupt operations.
- *Electricity transmission and distribution infrastructure*, including power lines and substations, is susceptible to severe weather and may be stressed by rising demand for electricity as temperatures rise.

In addition, impacts to infrastructure may also be amplified by a number of broad, systemic factors, including water scarcity, energy system interdependencies, increased electricity demand, and the compounding effects of multiple climate impacts.

A number of measures exist to help reduce climate-related risks and adapt the nation's energy systems to weather and climate-related impacts. These options generally fall into two broad categories—hardening and resiliency. Hardening measures involve physical changes that improve the durability and stability of specific pieces of infrastructure—for example, elevating and sealing water-sensitive equipment—making it less susceptible to damage. In contrast, resiliency measures allow energy systems to continue operating after damage and allow them to recover more quickly; for example, installing back-up generators to restore electricity more quickly after severe weather events.

In general, the federal government has a limited role in directly adapting energy infrastructure to the potential impacts of climate change, but key federal entities can play important supporting roles that can influence private companies' infrastructure decisions and these federal entities are initiating steps to begin adaptation efforts within their respective missions. Energy infrastructure adaptation is primarily accomplished through planning and investment decisions made by private companies that own the infrastructure. The federal government can influence companies' decisions through providing information, regulatory oversight, technology research and development, and market incentives and disincentives. Key federal entities, such as the Department of Energy, the Environmental Protection Agency, the Federal Energy Regulatory Commission, and the Nuclear Regulatory Commission have also begun to take steps to address climate change risks—through project-specific activities such as research and development and evaluating siting and licensing decisions under their jurisdiction, as well as through broader agency-wide assessments and interagency cooperation.