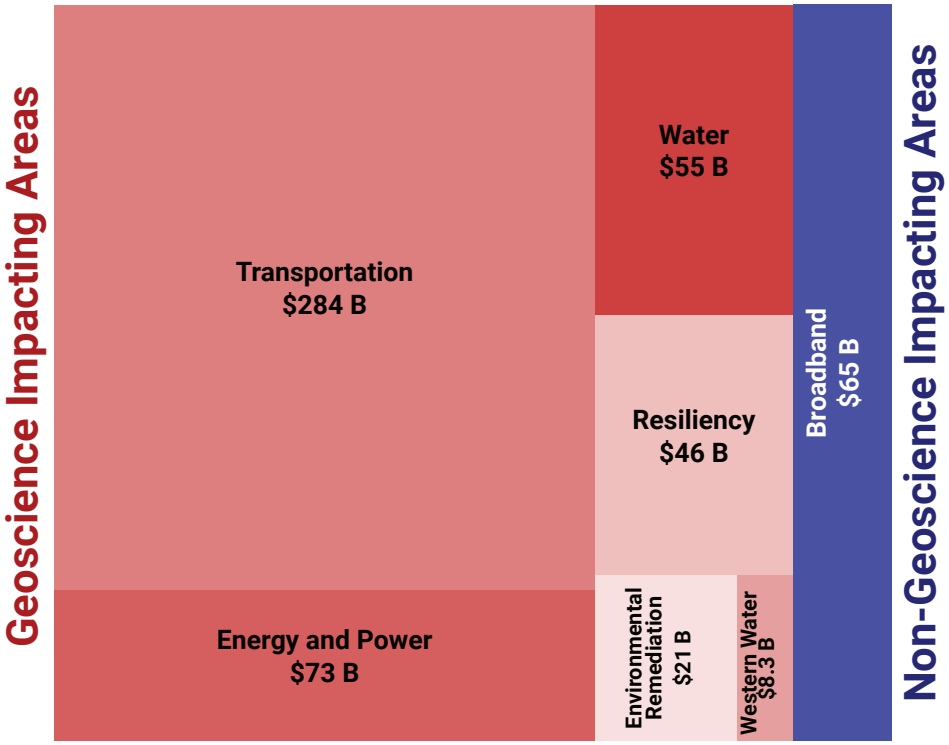
american geosciences institute
connecting earth, science, and people

Geoscience Solutions for Future Infrastructure

GEOSCIENCES IMPACT ON INFRASTRUCTURE

The geosciences are vital for the development of resilient and sustainable infrastructure because they reveal important information about the formation and location of the raw materials needed for its manufacture and construction. Geoscientists incorporate geology, hydrology, and environmental science to determine the best locations for infrastructure projects, evaluate natural hazards, and ensure the sustainability of natural resources. Their skills enable the design of infrastructure that can resist natural disasters such as earthquakes, floods, and landslides, thereby protecting human lives and investments. Moreover, geoscientific research supports the innovative use of materials and techniques that minimize environmental impact, such as identifying local sources of construction aggregate to lower carbon footprints. By incorporating geoscience knowledge into infrastructure planning and development, we can achieve not only more durable and cost-effective facilities but also foster environmental stewardship and resilience against the changing climate.

Funding Distribution in the Infrastructure Bill



Successful development and management of infrastructure is reliant on geoscientists to ensure access to necessary resources, stability of the land, protection of the environment, and the ability to predict weather that impacts transport and the built environment. The Infrastructure Investment and Jobs Act allocated investments across a wide range of needs, and many of those sectors (red hues) are underpinned by geoscientific expertise to ensure success.

On Stable Ground
Topographic and geologic information informs where infrastructure can be safely located as well as sites for the safe disposal of infrastructure waste products.

Critical Minerals for All Development
Geologic resource information is required to locate new sources of needed critical minerals and other raw materials.

Safe and Sustainable Development
Environmental geologists provide the guidance and information needed to ensure projects can be built safely and sustainably.

Locating for Future Energy
Climate scientists develop projections for long-term climate trends for improved planning for wind and solar energy developments, as well as the energy transmission infrastructure that will be critical for building a 21st century energy grid.

Building for the Long-Haul
The design and construction of bridges, roads, pipelines, aqueducts, and levees are directly influenced by numerous geologic factors, including the structural integrity of the substrate and the subsurface conditions upon which the structures will be built.

Wise Development for Reduced Risk and Cost
Incorporating geoscience information into infrastructure construction maximizes the safety and efficiency of our systems, saving money and reducing risks.

Waste Management
Geoscientists contribute to the design and monitoring of waste disposal sites, including landfills and hazardous waste containment facilities. They ensure that these sites do not contaminate groundwater or soil and assess remediation options for contaminated sites, making them safe for future use or development.

Urban Planning and Smart Cities
Geoscientific data and analysis support urban planning by providing insights into land use, natural resource availability, and environmental constraints. This information is crucial for the sustainable development of smart cities, which aim to optimize resource use, reduce pollution, and improve residents' quality of life.

EXEMPLARS OF IMPACTS OF GEOSCIENCE ON INFRASTRUCTURE

As the Nation transitions its energy portfolio, geoscience research can significantly aid in maximizing the economic return on investment through incorporation of geological information for construction of solar, wind, geothermal, hydroelectric, and nuclear power developments to reduce costs and construction time.

Residential and business structures in both cities and rural areas require stable foundations to ensure long-term stability and sustainability as well as protect against natural hazards such as earthquakes, wind, flooding, landslides, sinkholes, and erosion.

Water can cause extreme problems for infrastructure. For example, saline water associated with rising sea-levels can react with concrete-supported infrastructure, weakening the concrete and corroding support steel, leading to reduced useful lifetimes. Urban areas contain a high percentage of impermeable surfaces, and thus need hydrologic modelling and design to manage storm water and runoff. This is critical information for developing resilient and cost-effective city and suburban landscapes. Creative designs will be needed to make new infrastructure as efficient and adaptable as possible to counter the uncertainties related to climate change.

CASE STUDIES

The construction of the new span of the San Francisco-Oakland Bay Bridge, completed in 2013, required extensive geological surveys to source and utilize materials capable of withstanding seismic events, leading to the selection of specific high-strength steel and concrete formulations.

The implementation of the Los Angeles County Flood Control District's Enhanced Watershed Management Program (EWMP) utilizes geological and hydrological data to mitigate flood risks while improving water quality through naturalized detention basins and green infrastructure.

The restoration of the Florida Everglades through the Comprehensive Everglades Restoration Plan (CERP) involves geological assessments to guide the re-routing of water flow and the restoration of natural water filtration systems, aiming to preserve this unique ecosystem.

The development of the Ivanpah Solar Power Facility in California's Mojave Desert was preceded by detailed geological and environmental studies to ensure minimal impact on the desert ecosystem while harnessing solar energy efficiently.

EXAMPLES OF RELEVANT LEGISLATION AND POLICY

Executive Orders

- **E.O. 13956:** Aims to modernize water resource management and infrastructure particularly to improve water storage capacity and drought resilience.

Congressional Legislation

- **117th—H.R. 5376:** The Inflation Reduction Act spurred on massive investments in new infrastructure efforts across the United States.
- **118th—H.R. 302:** Direction for the department of energy to provide assistance programs for graduate students and post-grad researchers in pursuance of research focused on cyber security and energy infrastructure.

Relevant Federal Agencies

- Environmental Protection Agency
- U.S. Department of Transportation
- Army Corps of Engineers

Related National Academy Reports

- Transforming EPA Science to Meet Today's and Tomorrow's Challenges (2023)
- Benefits, Applications, and Opportunities of Natural Infrastructure: Proceedings of a Workshop—in Brief (2022)
- Climate-Resilient Supply Chains: Proceedings of a Workshop–in Brief (2022)
- Planning the Future Space Weather Operations and Research Infrastructure: Proceedings of a Workshop (2021)

Non-Partisan Non-Profit Expertise

- American Association of Geographers
- American Association of Petroleum Geologists
- American Institute of Hydrology
- American Institute of Professional Geoscientists
- Association of American State Geologists
- Association of Environmental and Engineering Geologists
- Mineralogical Society of America
- National Groundwater Association
- National Sand, Stone, and Gravel Association
- Society of Economic Geologists
- Society of Exploration Geophysicists
- Society for Mining, Metallurgy, and Exploration