



## SUBCOMMITTEE ON RESEARCH AND TECHNOLOGY

### HEARING CHARTER

#### *“From Risk to Resilience: Reauthorizing the Earthquake and Windstorm Hazards Reduction Programs”*

**Tuesday, January 30, 2024  
2:00 p.m.  
2318 Rayburn House Office Building**

#### **Purpose**

The purpose of the hearing is to review federal natural hazard research and development (R&D) programs, specifically, the National Windstorm Impact Reduction Program (NWIRP) and the National Earthquake Hazards Reduction Program (NEHRP), to examine the strengths, weaknesses, and challenges of the interagency effort, and to receive recommendations for future reauthorization of the programs.

#### **Witnesses**

- **Mr. Jason Averill**, Deputy Director of the Engineering Laboratory, National Institute of Standards and Technology
- **Mr. Edward Laatsch, P.E.**, Director, Safety, Planning, and Building Science Division, Risk Analysis, Planning and Information Directorate, Federal Emergency Management Agency
- **Dr. Gavin Hayes**, Earthquake Hazards Program Coordinator, United States Geological Survey
- **Dr. Susan Margulies**, Assistant Director for Engineering, National Science Foundation

#### **Overarching Questions**

- How have NWIRP and NEHRP improved the understanding of windstorms and earthquakes, along with their impacts, and increased resilience?
- How does the collaboration between the hazards program agencies help advance the goals of the respective programs?
- How do NIST and FEMA take research supported by NWIRP and NEHRP, such as the NSF’s RAPID Response grants, and translate it into best practices and building codes that may be voluntarily adopted by international organizations and local communities?

- What are the new and evolving challenges to improving hazard resilience and how can these hazard programs address those challenges?
- What are the additional needs in research, workforce, and research infrastructure for improved hazard and hazard impact resilience?
- What updates are needed to the existing NWIRP and NEHRP authorizations to enable these programs to fully address any gaps and emerging challenges?

## **Background**

### **Windstorm Risk and Hazard in the United States**

High winds in hurricanes, tornados, thunderstorms, and other wind-related weather phenomena are the largest loss-producing natural hazards in the United States. During the period from 1982 to 2022, windstorms triggered over \$1.7 trillion in economic losses and caused over 8,000 fatalities.<sup>1</sup> All 50 states are exposed to windstorm hazards, including tornadoes, tropical cyclones, thunderstorms, nor'easters, winter storms, and mountain downslope winds, as well as others. According to the NWIRP Strategic Plan, tornadoes have caused an average loss of over \$10 billion per year.<sup>2</sup> 2017 was a record-breaking year for windstorm losses in the United States with Hurricanes Harvey (\$125 billion estimated damage), Irma (\$50 billion estimated damage), and Maria (\$90 billion estimated) comprising approximately 80 percent of the \$306.2 billion total of extreme weather and climate events.<sup>3</sup> The most intense windstorms, hurricanes, and tornadoes have the potential to impact national security by producing devastating damage to critical infrastructure, including, for example, defense facilities, ports, airports, communication and power grids, critical manufacturing, financial services, and nuclear facilities.

The Congressional Budget Office (CBO) has reported it expects the costs associated with hurricanes to increase more rapidly than the growth of the economy.<sup>4</sup> Much of the precipitous increase in property losses is due to the rise of population in vulnerable coastal areas. According to the National Oceanic and Atmospheric Administration (NOAA), approximately 40 percent of Americans live in coastal communities and this upward trend is projected to continue.<sup>5</sup> Similarly, population growth in tornado alley will likely result in increased loss of life and property damage, unless cost-effective measures are taken to reduce the impact of tornadoes on buildings and infrastructure. Those dwelling in manufactured housing (i.e. mobile homes) are at an increased risk of death, injury, and property loss from high-wind storms.

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<sup>1</sup> NOAA National Centers for Environmental Information, U.S. Billion-Dollar Weather and Climate Disasters, 1982-2022 <https://www.ncei.noaa.gov/access/billions/>

<sup>2</sup> Strategic Plan for the National Windstorm Impact Reduction Program, NIST, 2018 [https://www.nist.gov/system/files/documents/2018/09/24/nwirp\\_strategic\\_plan.pdf](https://www.nist.gov/system/files/documents/2018/09/24/nwirp_strategic_plan.pdf)

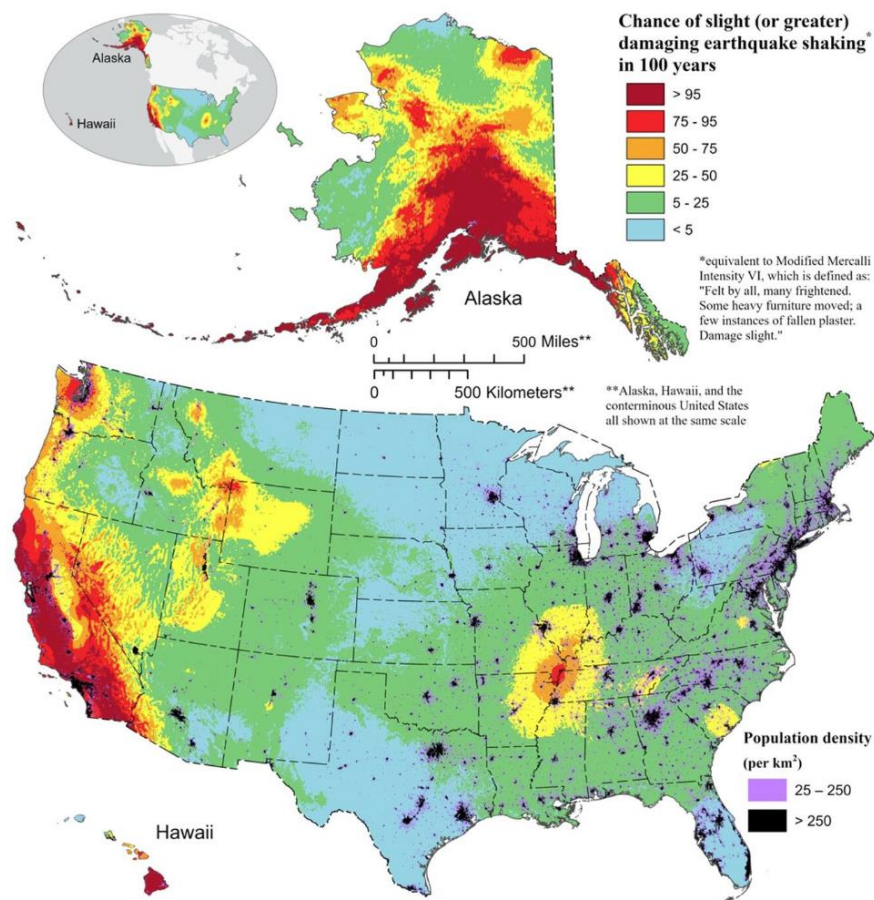
<sup>3</sup> *Ibid.*

<sup>4</sup> Potential Increases in Hurricane Damage in the United States: Implications for the Federal Budget, CBO, June 2016 <https://www.cbo.gov/publication/51518>.

<sup>5</sup> NOAA Office for Coastal Management, Economics and Demographics, 2018 [https://coast.noaa.gov/states/fast-facts/economics-and-demographics.html#:~:text=Live%20on%20the%20Coast,land%20mass%20\(excluding%20Alaska\)](https://coast.noaa.gov/states/fast-facts/economics-and-demographics.html#:~:text=Live%20on%20the%20Coast,land%20mass%20(excluding%20Alaska)).

## Earthquake Risk and Hazard in the United States

Nearly 75 percent of the United States faces some risk from earthquakes, and portions of all 50 states and the District of Columbia are vulnerable to earthquake hazards.<sup>6</sup> 37 states have experienced earthquakes of magnitude 5 or greater during the last 200 years.<sup>7</sup> Seismic hazards are greatest in the western United States, particularly in California, Washington, Oregon, Alaska, and Hawaii. Alaska is the most earthquake-prone state, experiencing a magnitude-7 earthquake almost every year and a magnitude-8 or greater earthquake on average every 13 years, since 1990. Because of its low population and infrastructure density, Alaska has a relatively low risk of large economic losses from an earthquake. In contrast, California has more citizens and infrastructure at risk than any other state because of its frequent seismic activity, large population, and extensive infrastructure.<sup>8</sup>



Sources/Usage: Public Domain.

National Seismic Hazard Model (2023). Map displays the likelihood of damaging earthquake shaking in the United States over the next 100 years.

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<sup>6</sup> USGS Press Release, New USGS Map shows where damaging earthquakes are most likely to occur in US, January 16, 2024 <https://www.usgs.gov/news/national-news-release/new-usgs-map-shows-where-damaging-earthquakes-are-most-likely-occur-us>

<sup>7</sup> *Ibid.*

<sup>8</sup> CRS Report: R43141, *The National Earthquake Hazards Reduction Program (NEHRP): Overview and Issues for Congress*, July 20, 2023 <https://crsreports.congress.gov/product/pdf/R/R43141>

<sup>9</sup> *Supra* note 6.

The United States faces the possibility of large economic losses from earthquake-damaged buildings and infrastructure. The Federal Emergency Management Agency (FEMA) and the United States Geological Survey (USGS) estimate earthquake losses in the United States, on average, to be \$14.7 billion per year.<sup>10</sup> California, Washington, and Oregon account for nearly \$11.6 billion (78 percent) of the U.S. total estimated average annualized loss. California alone accounts for most of the estimated annualized earthquake losses for the nation with \$9.6 billion (65 percent) of average annualized loss.

Unlike other natural hazards, such as hurricanes, where predictions of the location and timing of landfall are becoming increasingly accurate, the scientific understanding of earthquakes does not yet allow for precise earthquake prediction. Instead, communications typically involve conveying the location and magnitude of an earthquake as soon as possible after the event to emergency response providers and others who need the information.

### **The National Windstorm Impact Reduction Program (NWIRP)**

NWIRP was established by Congress in 2004 “...to achieve major measurable reductions in the losses of life and property from windstorms through a coordinated Federal effort, in cooperation with other levels of government, academia, and the private sector, aimed at improving the understanding of windstorms and their impacts and developing and encouraging the implementation of cost-effective mitigation measures to reduce those impacts.”

With the enactment of PL 114-52, the National Windstorm Impact Reduction Act Reauthorization of 2015, on September 30, 2015<sup>11</sup>, the National Institute of Standards and Technology (NIST) has been designated as the Lead Agency for NWIRP. Other designated Program agencies are the Federal Emergency Management Agency (FEMA), the National Oceanic and Atmospheric Administration (NOAA), and the National Science Foundation (NSF). Other federal agencies are invited to participate in NWIRP activities. Among those already involved are the Federal Highway Administration (FHWA), the Department of Housing and Urban Development (HUD), the U.S. Army Corps of Engineers (USACE), and the Department of Energy (DOE).

Primary responsibilities for the NWIRP agencies break down as follows:

- **NIST** is the lead NWIRP agency and has responsibility for the planning and coordination of the program. NIST also carries out research and development to improve model building codes, voluntary standards, and best practices for the design, construction, and retrofit of buildings, structures, and lifelines.
- **FEMA** supports the development of risk assessment tools and effective mitigation techniques; windstorm-related data collection and analysis; public outreach and information dissemination; and promotion of the adoption of windstorm preparedness and mitigation measures, including for households, businesses, and communities. It also works closely with national standards and model building code organizations, in conjunction with NIST, to promote the implementation of research results and better building practices within the

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<sup>10</sup> FEMA Publication P-366, HAZUS MH Estimated Annualized Earthquake Losses for the United States, April 2023, [https://www.fema.gov/sites/default/files/documents/fema\\_p-366-hazus-estimated-annualized-earthquake-losses-united-states.pdf](https://www.fema.gov/sites/default/files/documents/fema_p-366-hazus-estimated-annualized-earthquake-losses-united-states.pdf)

<sup>11</sup> P.L. 114-52 <https://www.congress.gov/114/plaws/publ52/PLAW-114publ52.pdf>

building design and construction industry, including architects, engineers, contractors, builders, and inspectors.

- **NOAA** supports atmospheric sciences research to improve the understanding of the behavior of windstorms and their impact on buildings, structures, and lifelines. Specifically, this research aims to improve observations of physical phenomena, collection and archival of windstorm and post-windstorm data, development of novel data assimilation and forecasting techniques, and applications of observations, models, and forecasts related to windstorms.
- **NSF** carries out research and development to improve model building codes, voluntary standards, and best practices for the design, construction, and retrofit of buildings, structures, and lifelines.

The roles of the program agencies and other stakeholder organizations in the windstorm impact reduction process are shown schematically in the figure below.<sup>12</sup> This figure also identifies the connections among the major components and activities of NWIRP. Basic and applied research in science and engineering supports the development of methods, tools, and technologies for hazard and risk assessments and for improved design of the built environment, which in turn supports changes to national model codes, standards, and practices. State and local governments participate by adoption and enforcement of model codes and standards.

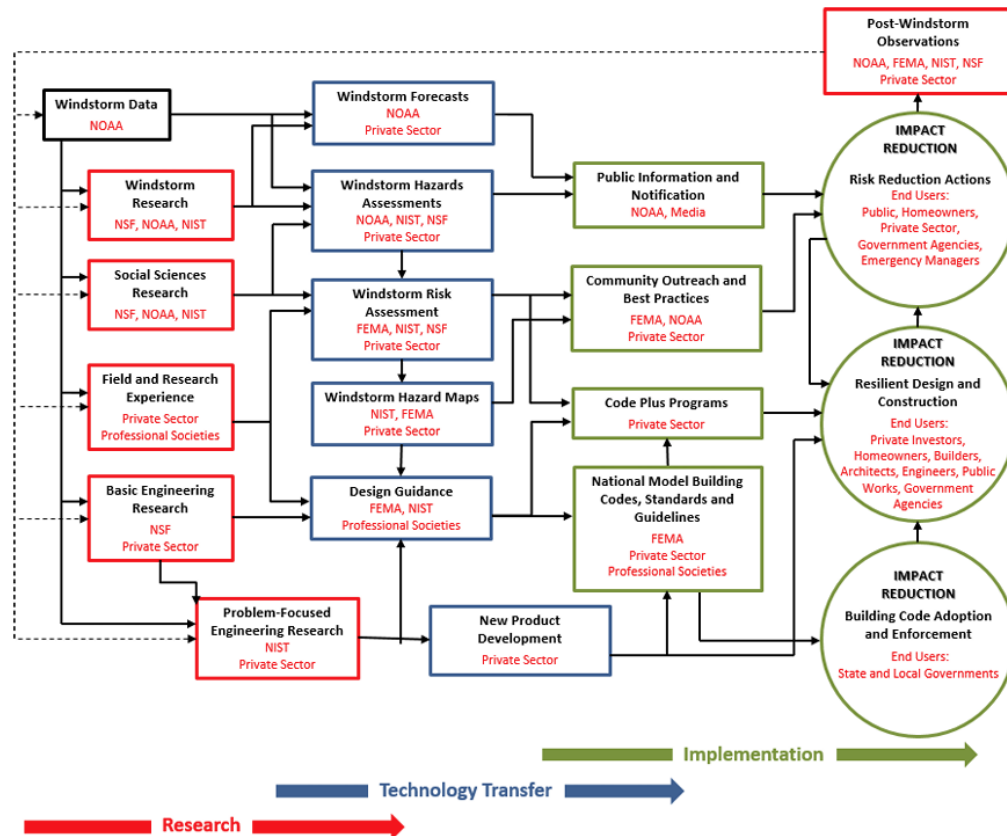


Figure 7. Roles of program agencies and other stakeholders in the windstorm impact reduction process

<sup>12</sup> *Supra* note 2.



Research and development activities conducted by NWIRP fall under three primary components: improved understanding of windstorms; windstorm impact assessment; and windstorm impact reduction. The 2015 reauthorization of NWIRP established an Interagency Coordinating Committee (ICC) to oversee the planning and coordination of NWIRP. The ICC is chaired by the Director of NIST and consists of the agency heads of the other three Program agencies, the Office of Management and Budget (OMB), as well as other appropriate federal agencies. Congress requires the ICC to develop a strategic plan and a coordinated budget for NWIRP. The four NWIRP agencies carry out research, development, and dissemination activities in support of NWIRP goals, however, NWIRP does not appear as a line item in the agencies' budgets. The 2015 reauthorization authorized \$21.4 million total across the four NWIRP agencies for each of FY2015-FY2017 and has not been reauthorized since.

As part of the reauthorization of NWIRP in 2015, NIST was directed to establish an Advisory Committee on Windstorm Impact Reduction (ACWIR) with representatives from research and academic institutions, industry standards development organizations, emergency management agencies, state and local government, and business communities, including the insurance industry. The ACWIR report was issued in 2017 and made recommendations for the program,<sup>13</sup> including:

1. Place a greater emphasis on developing tools for evaluating the windstorm resistance of existing buildings and other infrastructure and for providing practical cost-effective guidance on retrofitting these buildings and other infrastructure to improve their windstorm resilience;
2. Conduct and promote social science research that provides a greater understanding of the portfolio of public policy approaches for promoting windstorm mitigation; and
3. Expand to consider all effects of land-falling hurricanes, including water intrusion and water-induced forces from waves, surges, and flooding, including rainfall-related flooding, near the coast.

### **The National Earthquake Hazards Reduction Program (NEHRP)**

In 1977, Congress passed the Earthquake Hazards Reduction Act (P.L. 95-124) establishing NEHRP as a long-term earthquake risk reduction program for the United States. The original program focused on research to understand and predict earthquakes. NEHRP's focus was changed in 1990, when Congress decreased the emphasis on earthquake prediction, expanded the program objectives, and required federal agencies to adopt seismic safety standards.

Currently under NEHRP, four federal agencies have responsibility for long-term earthquake risk reduction: NIST, FEMA, the NSF, and the United States Geological Survey (USGS). Current program activities are focused on four broad areas including supporting the development of effective earthquake hazard reduction measures; promoting the adoption of these measures by federal, state, and local governments; improving the basic understanding of earthquakes and their effects on people and infrastructure; and developing and maintaining the Advanced National Seismic System (ANSS) and the Global Seismic Network (GSN).

Primary responsibilities for the NEHRP agencies break down as follows:

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<sup>13</sup> Assessment of and Recommendations for the National Windstorm Impact Reduction Program and its Implementation, A Report from the National Advisory Committee on Windstorm Impact Reduction, (September 2017) [https://www.nist.gov/system/files/documents/2017/10/12/nacwir\\_assessments\\_and\\_recommendations\\_for\\_nwirp.pdf](https://www.nist.gov/system/files/documents/2017/10/12/nacwir_assessments_and_recommendations_for_nwirp.pdf)

- **NIST** is the lead NEHRP agency and has responsibility for the planning and coordination of the program. NIST also promotes earthquake-resistant design and construction practices through building codes, standards, and construction practices.
- **FEMA** assists other agencies and private-sector groups to prepare and disseminate building codes and practices for structures and lifelines, and it aids the development of performance-based codes for buildings and other structures.
- **NSF** supports basic research to improve the safety and performance of buildings, structures, and lifelines.
- **USGS** conducts research to assess earthquake causes and effects, produces national and regional seismic hazards maps, and monitors and rapidly reports on earthquakes and their shaking intensities in the U.S. and abroad. The USGS maintains the ANSS and the GSN, and is responsible for relaying this data in near-real time to NOAA's Tsunami Warning Centers.

The roles of the program agencies and other stakeholder organizations in impacting the built environment are shown schematically in the figure below.<sup>14</sup> The figure illustrates how the activities of NEHRP agencies fit together and complement one another. Throughout this process, the four NEHRP agencies interact with earthquake professionals in the private sector; in the national model building code organizations; in academia; and in state, local, tribal, and territorial government.

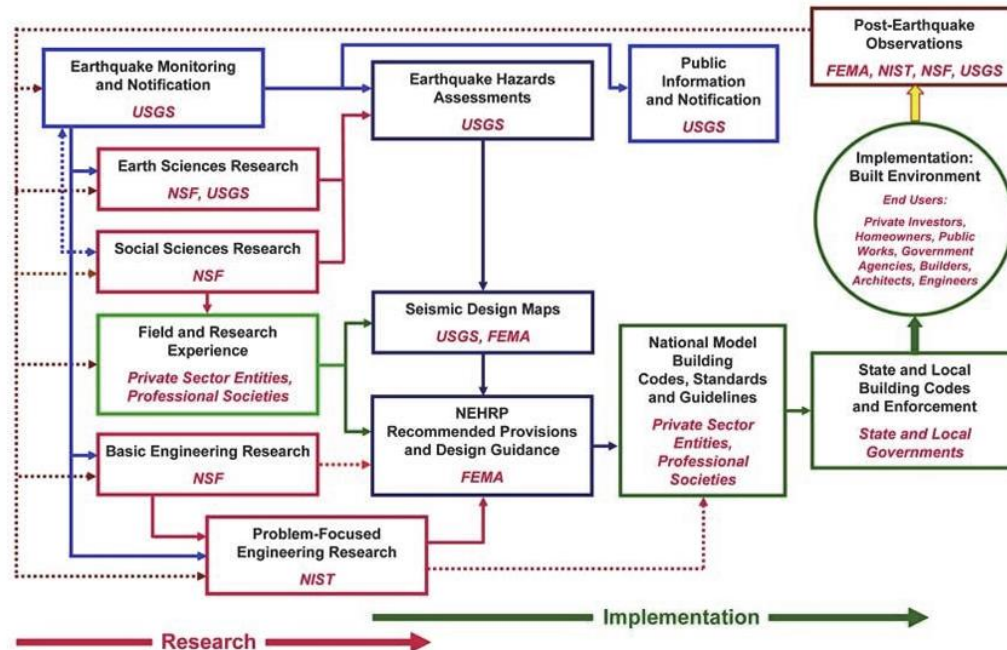


Figure B-1. NEHRP Impact on Building Design and Construction. Image courtesy of NIST.

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<sup>14</sup> Figure B-1. NEHRP Impact on Building Design and Construction. <https://www.nehrp.gov/pdf/FY2022-29%20NEHRP%20Strategic%20Plan%20-%20Post%20Version.pdf>

Research and development activities conducted by NEHRP fall under four primary components: develop effective measures for earthquake hazards reduction; promote the adoption of earthquake hazards reduction measures; improve understanding of earthquakes and their effects; and continue the development of the ANSS, a nationwide network of seismic stations. The 2018 reauthorization of NEHRP (P.L. 115-307) called for additional oversight, management planning, and strategic planning to enhance coordination, cooperation, and efficient progress on objectives.<sup>16</sup> It also expanded emphasis on earthquake early warning systems and added language to continue the development of the ANSS.

The bill also increased focus on earthquake-resistant construction and requested support for resilience, such as earthquake-resistant structures that continue to function after an event and communities that are prepared to respond effectively to and recover efficiently from a seismic event. The four NEHRP agencies carry out research, development, and dissemination activities in support of NEHRP goals, however, NEHRP does not appear as a line item in the agencies' budgets. The 2018 reauthorization authorized \$152.06 million total across the four NEHRP agencies for each of FY2019-FY2023.

As part of the reauthorization of 2018, the ICC was required to develop a strategic plan for NEHRP, a management plan to implement the strategic plan, and a coordinated interagency budget on a biennial basis. The ICC completed a strategic plan for FY2022-FY2029 with eight focus areas:

1. Advance earthquake science for subduction zone regions.
2. Develop enhanced performance-based seismic design procedures and metrics for functional recovery of buildings and infrastructure.
3. Advance performance-based seismic design and assessment methods to implement multisystem coordination.
4. Further expand earthquake early warning capabilities.
5. Develop consistent performance guidance for lifeline infrastructure.
6. Enhance guidance to ensure information and tools effectively support the needs of those who implement mitigation, preparedness, and recovery measures.
7. Advance the science of earthquake sequence characterization.
8. Enhance risk reduction strategies for federal agencies.

The 2018 reauthorization also directed the Government Accountability Office (GAO) to complete a review of federal earthquake hazard risk reduction efforts and report its findings within three years of enactment. GAO completed its review in 2022 and recommended seven actions:

1. Conduct a national risk assessment to identify progress and remaining gaps in earthquake resilience in communities.
2. Increase awareness among tribes about earthquake risk reduction initiatives.
3. Assess the need for state, local, territorial, and tribal input about research priorities to meet community needs.
4. Develop strategies to better communicate program priorities to research entities.
5. Develop performance measures and monitor research to achieve research priorities.
6. Leverage program resources to achieve research priority outcomes.

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<sup>16</sup> P.L. 115-307 <https://www.congress.gov/115/plaws/publ307/PLAW-115publ307.pdf>



7. Implement a plan to make state, local, territorial, and tribal stakeholders aware of practices for disseminating research.

### **Further Reading**

- **NWIRP Strategic Plan**
- **NWIRP Advisory Committee Report**
- **NWIRP Biennial Reports to Congress**
- **CRS Report: “Hazard-Resilient Buildings: Sustaining Occupancy and Function After a Natural Disaster”**
- **GAO Report: “Artificial Intelligence in Natural Hazard Modeling: Severe Storms, Hurricanes, Floods, and Wildfires”**
- **FEMA Building Codes Save: A Nationwide Study**
- **NEHRP Annual Reports, Budgets & Plans**
- **CRS Report: “The National Earthquake Hazards Reduction Program (NEHRP): Overview and Issues for Congress”**
- **GAO Report: “Earthquakes: Opportunities Exist to Further Assess Risk, Build Resilience, and Communicate Research”**
- **GAO Report: “Earthquakes: Progress Made to Implement Early Warning System, but Actions Needed to Improve Program Management”**