



Climate Change Adaptation Planning Document

July 2022



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How ARS is addressing climate change in its research programs and integrating climate adaptation into its operations to ensure it can fulfill its mission.

USDA Agricultural Research Service Climate Change Adaptation Planning Document July 2022

ARS has prepared this Climate Change Adaptation Plan in accordance with Departmental Regulation (DR) 1070-001, which provides guidance on the establishment and periodic revision of the USDA Climate Change Adaptation Plan and is consistent with implementation of Executive Order (E.O.) 14008, Executive Order on Tackling the Climate Crisis at Home and Abroad, issued on January 27, 2021. This plan describes how ARS addresses climate change in its research programs and is integrating climate adaptation into its operations to ensure it can fulfill its mission.

I. ARS Mission in relation to Climate Change Adaptation

ARS is the USDA’s chief in-house research agency and is one of four agencies in the USDA Research, Education, and Economics (REE) mission area. ARS has about 6,000 employees, including 2,000 scientists and post docs representing a range of disciplines. ARS has 660 research projects at 90+ locations, including overseas labs, and has an annual budget of \$1.5 billion.

The ARS Mission is to deliver scientific solutions to national and global agricultural challenges for American farmers, producers, industry, and communities to support the nourishment and well-being of all people; sustain our nation’s agroecosystems and natural resources; and ensure the economic competitiveness and excellence of our agriculture.

To achieve its mission, ARS identifies problems affecting American agriculture and plans and executes strategies needed to address these problems by mobilizing human, financial, and physical resources. ARS research is organized into four Science Areas: Nutrition, Food Safety, and Quality; Natural Resources and Sustainable Agricultural Systems; Crop Production and Protection; and Animal Production and Protection. These four Areas are in turn organized into 15 National Programs that ensure the most important research is conducted with minimal redundancy.

ARS Science Area	ARS National Program (Program number)
Nutrition, Food Safety and Quality	Human Nutrition (NP 107)
	Food Safety (NP 108)
	Product Quality and New Uses (NP 306)
Natural Resources and Sustainable Agricultural Systems	Water Availability and Watershed Management (NP 211)
	Soil and Air (NP 212)
	Grass, Forage, and Rangeland Agroecosystems (NP 215)
	Sustainable Agricultural Systems (NP 216)
Crop Production and Protection	Plant Genetic Resources, Genomics, and Genetic Improvement (NP 301)
	Plant Diseases (NP 303)
	Crop Protection and Quarantine (NP 304)
	Crop Production (NP 305)

Animal Production and Protection	Food Animal Production (NP 101)
	Animal Health (NP 103)
	Veterinary, Medical, and Urban Entomology (NP 104)
	Aquaculture (NP 106)

ARS does not have a climate change research program *per se*. Instead, research conducted in all ARS National Programs targets how agricultural systems can adapt to climate change and the potential for those systems to mitigate climate change. Adaptation research investigates how crop and animal systems might respond to predicted climate changes and how to make these systems more resilient, so they are less vulnerable to impacts on productivity and they conserve essential soil, air, and water resources. Mitigation research develops management practices and technologies that reduce fossil fuel use and greenhouse gas emissions (GHG), sequester carbon, and generate feedstocks or energy that offsets fossil fuel use. ARS scientists also study how climate and climate adaptation and mitigation affect food quality, safety, and security. ARS coordinates with other federal agencies through programs such as the USDA Climate Hubs to provide the science that informs policy, and partners with stakeholders to provide the practices, technologies, and decision tools needed for sustainable, profitable enterprises.

From a facilities and operations perspective, climate adaptation involves energy efficiency, water conservation, and sustainability efforts. ARS follows the REE Energy, Water, and Sustainability policy, P&P 134.2, which states: *Consistent with REE’s mission and without compromising health and safety, it is REE policy to give energy and water conservation as well as sustainability, prime consideration in the acquisition, use, and disposal of all property and in the performance of all functions. This action will reduce the impact of our activities on the environment and help conserve resources. Efficiency and conservation shall be integrated into the core activities of the Agency. It shall be every employee’s responsibility to ensure that every reasonable effort is made to reduce operating costs and conserve energy, water, and resources.*

II. ARS Vulnerabilities to Impacts of Climate Change

1. Vulnerabilities of ARS Research Resources

ARS research activities happen in many places, but they can be broadly grouped into indoor facilities and outdoor areas. Both are vulnerable to the impacts of climate change.

ARS indoor facilities include labs, workshops, greenhouses, and barns that have several vulnerabilities to increasingly intense and frequent severe weather. Whenever facilities are damaged, in addition to repair and replacement costs, there is significant impact on ARS research capacity through interruption or loss of ongoing experiments, delays in planned research, and obstacles related to placing people and resources in temporary space. ARS encourages its research locations and programs to have a Continuity of Operations Plan (COOP) to continue critical operations during severe weather impacts. Considerations are detailed in the next section on Vulnerabilities of ARS facilities.

ARS outdoor research is also diverse, occurring in many climates and places, and at different scales, from small scale field plots over a few years to large scale landscape or watershed research over decades. Outdoor research is also diverse and broadly includes crop production, animal production, and environmental monitoring of air, soil, and water, and often animal (e.g., insects) resources. Research is often designed to incorporate climate change adaptation, such as the impact of increasing atmospheric CO₂ on crops and weeds, and what crops and animals are best adapted to drought and heat stress. However, there is extensive non-climate research where drought or extreme weather can negatively impact or cause complete loss of experiments. ARS research Project Plans intentionally include a section where scientists document vulnerabilities of their research and contingencies for how they will adapt research, including climate considerations.

ARS is committed to the humane treatment of its research animals, especially as it relates to climate, such as heat stress or changing pest and disease management. Vulnerability to utility interruption is a concern for animal facilities. Space conditioning, air change rates, and availability of drinking water cannot be allowed to be compromised. Exposure to extreme weather and other climate conditions can threaten animals with physical harm, dangerous heat or cold, flooding, emotional stress, and difficulty getting food, water, or other necessities of life. Maintaining animal facilities is a critical priority. Both facility and research planning account for weather impacts, and any impacts of weather are addressed and remedied immediately.

2. Vulnerabilities of ARS Facilities, Fleet, and Personnel

Facilities: ARS has 3,170 buildings in 94 domestic locations and one foreign location, the National Agricultural Library, and 86 worksites. Severe weather and storms are happening with increased intensity and frequency and can impose significant cost for facility and resource replacement.

ARS is evaluating and upgrading building design and planning for extreme weather considerations, such as severe drought and risk of fire. Storm and sanitary sewer capacity needs, security, biocontainment, and contamination risks can also result from extreme weather events. For example, loss or contamination of research can result from physical damage or utility interruption. Refrigeration of research and germplasm repositories require reliable power and backup generators. Security of pathogens and agents can be threatened after storms and power outages. Chemicals and spills can create dangerous situations and occupant exposure risks when ventilation systems lose power.

The sections below describe facility vulnerabilities posed by climate change and the actions ARS is taking to address those vulnerabilities.

- **Energy Security** is critical to ARS mission continuity. The ability to purchase, produce, and store energy provides the resilience needed for survival and recovery, or the orderly shutdown and transfer of operations because of a weather event.

Energy Sustainability in ARS follows the December 2020 Guiding Principles for Sustainable Federal Buildings and receiving certification from a 3rd party such as LEED or Green

Globes. The Energy Independence and Security Act of 2007 (EISA) requires that large new construction or modernization projects follow the methodology of LEED or Green Globes to measure sustainability, and a minimum of 5% of new construction projects must be submitted for certification. If a building is submitted for certification, it must also comply with the guiding principles to be sustainable. ARS policy is to meet LEED Silver to two Green Globes to be sustainable, plus comply with the guiding principles.

Building electrification is a strategy ARS is considering for energy efficiency. EISA Section 433 requires Agencies to design buildings after 2020 to reduce fossil fuel energy use 80%, and 100% by 2030. For example, ARS is leveraging technologies such as heat pumps to heat and cool spaces and heat water without fossil fuels.

Energy Redundancy is using standby technology, duplicate equipment, or secondary fuels to maintain service. ARS is positioning facilities to have energy redundancy as:

- Secondary fuels with the lowest greenhouse gas emissions.
- Duplicate equipment to operate individually when one fails, together during high demand, or rigged for alternating service.
- Backup power like emergency generators, uninterruptible power supplies (UPS), surge protectors, and batteries are commonly used on ARS facilities that need constant electricity.

Renewable Energy includes photovoltaic (PV), solar thermal, geothermal, wind, biomass, hydroelectric, and renewable alternative fuels. Federal Agencies are statutorily required to purchase or produce 7.5% of their electricity consumption in renewables, by EPCA 2005 section 203. ARS purchases Renewable Energy Certificates (RECs) to fulfill this requirement.

ARS surveys its facilities for renewable energy opportunities, and efforts to increase use of renewable energy include:

- 7 locations with photovoltaic arrays, two of which are net zero electric facilities. ARS has developed a proven RFP for photovoltaic projects that won a Federal Energy and Water Management Award in 2019.
 - 2 solar thermal projects that produce 42 million BTUs of energy annually.
 - 1 open loop geothermal system that uses a plate and frame heat exchanger to precool chiller water. ARS explored geothermal systems at two locations when the boilers were being replaced. Neither of them were viable.
 - ARS facility in Beltsville, MD, won a Closing the Circle award in 2008 for using B20 Biodiesel in its diesel farm equipment. The program was discontinued several years later for economic reasons.
- **Water Security:** Human non-potable water is used by ARS for agricultural purposes, such as irrigation, animal watering, and aquaculture. ARS continues to improve its agricultural irrigation systems to optimize both the amount of water used and the energy used to move that water in pumping. One ARS location, the Western Human Nutrition Research Center at Davis CA, uses greywater provided by the university; and another at Riverside, CA, uses

water that has been used for research and is ready for discharge. Greywater is untreated or partially treated but not fit for human consumption.

- **Threats to property**: ARS owns miles of overhead and buried power wiring, transformers, electric substations, underground steam pipes, underground natural gas pipes, and underground domestic water and sewer lines, all of which are vulnerable to severe weather and need periodic maintenance to improve and maintain reliability, functionality, and resiliency. ARS performs regular and preventive maintenance to keep buildings and equipment in optimal condition to resist and survive severe weather. The risk of storm damage is addressed by incorporating proper structural design criteria into ARS' Design Manual P&P 242.1.

- **Climate Related Resources**: The following is a list of strategies ARS uses to address its energy, water, and building resource use and security related to climate change.
 - Using Biobased (or BioPreferredSM) products (<http://www.biopreferred.gov/>).
 - Incorporating products with recycled content into projects to reduce the embodied energy and divert waste.
 - Selecting Energy Star products.
 - Leveraging the WaterSense[®] program, a national voluntary partnership program administered by EPA that offers a simple way to identify water-efficient products and practitioners.
 - Applying the Safer Choice EPA Pollution Prevention (P2) program to reduce, eliminate, or prevent pollution at its source.
 - Implementing the SmartWay EPA program to help the freight transportation sector improve supply chain efficiency.
 - Re-commissioning to ensure optimum performance of a facility, in accordance with design or current operating needs, over the useful life of the facility, while meeting building occupancy requirements.
 - Conducting energy audits to identify energy and water conservation measures and capital improvements that will save energy and water.
 - Leasing sustainable buildings that use LEED, Green Globes, or Energy Star Portfolio Manager.
 - Using Performance Contracting to take advantage of private sector capital to fund energy and water saving equipment and renewable energy systems at Federal facilities.

Personnel, Fleet, and Travel: There are many weather- and climate-related impacts on personnel, including heat stress, severe cold, flooding, wind, and accidents associated with loss of control of equipment or hazardous chemicals. A striking example is the impact of Hurricane Katrina on the ARS personnel at the Southern Regional Research Center in New Orleans, LA. Major damage and flooding rendered the Center completely unusable. A total of 178 employees, along with their families, had to be relocated to 22 temporary duty stations in 12 states to maintain research projects. Personnel-related costs totaled more than \$4 million over 3 fiscal years. ARS continues to implement and refine Health and Safety alerts and

communications applications to keep personnel informed and safe during extreme weather events.

ARS promotes energy efficiency in personnel transportation, including use of telework, and use of lower emission commuting, public transportation, and ridesharing. ARS is also optimizing business travel by leveraging virtual meetings and using travel methods with the optimal GHG impact considering time, cost, and availability.

ARS has 2,700 vehicles and replaces about 250 vehicles per year. ARS is optimizing purchasing and using fleet vehicles and equipment to make progress towards zero emissions, including using renewable alternative fuels such as in E-85 vehicles, EV, and Plug-in Hybrid Electric Vehicles (PHEV). ARS has one Level 2 EV Charging Station in Las Cruces, NM, and looks to expand GOV charging stations for fleet vehicles as well as for guests visits.

III. ARS Actions Related to Adapting to Climate Vulnerabilities

1. Facilities

The previous section includes discussion of actions ARS is taking to ensure that facilities and operations are adapting to climate vulnerabilities. Other specific examples include:

- Applying COOP plans to continue critical operations at ARS locations under a range of circumstances, including weather impacts.
- Implementing renewable energy and microgrids. ARS has one net-zero electricity facility, and another just completed construction. Other photovoltaic energy projects are in procurement and under development. Geothermal energy is used at one location, and its use has been studied at two other locations. Two facilities have solar thermal hot water.
- Investing in personnel trained and qualified to administer renewable energy projects, interconnection agreements, and utility contracts, such as engineers, contracting officers, and attorneys.
- Improving condition and resilience of electrical, steam, natural gas, and water infrastructure. Leak test all domestic and irrigation water systems that show inconsistent consumption or lack of integrity. Perform preventive maintenance and promptly make cost effective and technically feasible repairs.
- Switching fuels, using dual fuel equipment, and reducing carbon footprint. Convert heating plants burning fuel oil to natural gas or propane with high efficiency boilers. ARS has converted four locations away from fuel oil; one more location and several small buildings that still use fuel oil should be converted. Convert steam systems to hot water. Reduce the carbon footprint of small buildings by converting heating and hot water equipment from fossil fuels to electric systems, especially where they can be powered by solar panels. Install solar thermal systems. Convert to use of dual fuel boilers where the secondary fuel has low greenhouse gas emission (e.g., propane). Convert emergency generators to natural gas or tier 4 final Diesel fuel.
- Leveraging the Fixing America's Surface Transportation (FAST) Act to install EV charging stations at ARS locations for government and private vehicles.

2. Research

ARS recognizes the need to constantly pursue cutting edge research as well as interdisciplinary research that tackles agriculture’s “wicked problems” like climate adaptation. Examples of administratively supported programs to do this are:

- *ARSx*: a high-risk, high-reward research funding competition that encourages ARS scientists to put forward their breakthrough ideas for a transformative solution to a serious agricultural problem. Two themes addressed so far in 2020 and 2021 include “Harvest for a Healthier Future” and “Disruptive Pests and Pathogens”, both of which considered climate change in their evaluation criteria.
- *Grand Challenge Synergies* supports projects for greater impact than conventional ARS projects by facilitating and incentivizing synergistic interactions between scientists across locations, National Programs, and research systems. Synergistic projects harness the energy of diverse scientific teams to address complex problems of high national importance that may not be solved within the boundaries of a single discipline. Current Grand Challenge projects include climate related topics like pest and disease pressure on crops, the impact on dairy forage feed quality in different climates on milk nutritional properties, and beef cattle adaptation to different environments throughout the Northern and Southern Plains.

Beyond its conventional research planning process described in Section IV.2 below, ARS recognizes that research needed to support the agricultural industry in response to climate change must be transformative. Scientists representing all aspects of the agricultural supply chain must work more effectively with not only each other but also non-science partners in large, integrated teams. Examples of how ARS is responding to this new research paradigm include:

- *Long Term Agroecosystems Research* (LTAR, <https://ltar.ars.usda.gov/>): Network of 18 research locations combining strategic research projects with common measurements on multiple agroecosystems (croplands, rangelands, and pasturelands) and developing new technologies to address local and national challenges, with a focus on climate change adaptation and mitigation.
- *GRACEnet* (Greenhouse gas Reduction through Agricultural Carbon Enhancement): Network of 34 research locations whose coordinated research goals are to better quantify GHG emissions from cropped and grazed soils under current management practices and to identify and develop improved management practices that will enhance carbon sequestration in soils, decrease GHG emissions, promote sustainability, and provide a scientific basis for carbon credits and GHG trading programs.
- *Conservation Effects Assessment Project (CEAP) Watershed Assessment Study (WAS)*: Working in 14 benchmark watersheds at 12 ARS locations to provide scientific basis for the CEAP National Assessment being led by NRCS to provide a better understanding of how agricultural conservation practices and programs impact the nation's environmental objectives for clean air and water, healthy soils, and functioning habitat for wildlife.
- *Resilient Economic Agricultural Practices (REAP)*: Multi-location team that formed to identify biomass feedstock harvest rates and management that would sustain soil

resources. Current focus is soil health and resilience as a focal point to sustainably intensify the provision of food, feed, fiber and fuel; increased soil carbon; efficient nutrient cycling; improved water quality; and economically sustainable agricultural opportunities.

- *Breeding Insights Platform*: Coordinated team of specialists in information technology, genomics, and breeding process that partners with ARS plant and animal breeding research groups to leverage recent improvements in genomics and open-source informatics components so they can harness powerful digital tools to accelerate their genetic gains towards climate adaptation.

ARS is also committed to broadening access to and availability of its climate-related research data at regional and local scales for USDA Mission Areas, producers, land managers, and other stakeholders. A primary example is the *ARS Partnerships for Data Innovations (PDI)*. Established in 2019, PDI intends to seize the potential of data-driven technologies to build a culture of data stewardship. PDI is integrating customer-partners in developing and implementing state-of-the-art digital tools, leveraging off-the-shelf technologies when advantageous. In its short life, PDI has transformed more than 100 projects, from projects catalyzing collaborative efforts and underpinning information management to those salvaging end-of-life data repositories. Empowered by this active inclusive partnership and through sharing digital solutions on a “Digital Research Workbench” within the ARS Agricultural Collaborative Research Outcomes System infrastructure, PDI hopes to accelerate agricultural research through data standardization, automation, and integration.

IV. Sustaining and Evaluating Adaptation Progress

1. Facilities

ARS is taking steps to document facility progress toward climate adaption. Examples include:

- *Reports and records*
 - ARS prepares and submits an annual energy report each year that benchmarks consumption and cost of electricity, renewable energy, fuel oil, natural gas, propane, purchased steam, purchased chilled water, bulk fuels, and potable water as well as documents building efficiency, performance contracts, and training.
 - The Compliance Tracking System reports energy audits and projects to implement them.
 - Corporate Property Automated Information System (CPAIS) tracks sustainable buildings.
 - The annual Waste and Recycling report tracks waste and waste diversion by facility.
- *Environmental Management System (EMS)*: ARS implements an EMS at each location in accordance with the ISO 14001 standard. An EMS provides a framework for a continual cycle of planning, implementing, reviewing, and improving to allow an organization to consistently address the effects its operations may have on the environment and support continual improvement. Through the EMS, each location can track environmental compliance requirements and energy, transportation, and

other conservation efforts, collectively called “sustainability” requirements, by identifying specific aspects and their impacts, and establishing goals, objectives, and targets and monitor progress towards achievement of goals. ISO 14001, 14090, and 50001 are standardized approaches to EMS. ARS demonstrates conformity with ISO 14001 through self-determination and/or self-declaration, and in some cases, by seeking confirmation of its self-declaration by a party external to the organization (usually reserved for some of the larger centers or facilities).

- *3rd party sustainability certification.* ARS is leveraging LEED, Green Globes, and Energy Star methods to measure sustainability and benchmark utilities.

2. Research

ARS uses a robust and transparent planning and implementation process to integrate climate change research priorities into its programs, and to sustain and evaluate progress toward achieving those objectives. On 5-year cycles, each ARS National Program develops a research action plan that is informed by extensive stakeholder and partner input and considers the program’s human and fiscal resources. This stakeholder information is gathered through surveys, listening sessions, and research location meetings. An action plan is developed to set the program research priorities and anticipated products. Scientists in the program in turn develop their research project plans to align with the action plan. These project plans detail specific research activities for the 5-year cycle. This process ensures that research is aligned from the individual scientist all the way through to the ARS Strategic Plan, thereby ensuring continuity with the USDA, REE, and ARS visions for agricultural research.

Each year, all locations and National Programs develop annual reports to document their progress toward achieving their objectives. The location reports in particular offer an opportunity to document and communicate challenges that locations face in completing research and adaptation they are implementing, including those to deal with climate change issues. At the National Program level, towards the end of a 5-year cycle, a program conducts a retrospective analysis to see how well the priorities and products of its action plan were achieved and to help inform the program about potential for improvement and adaptation.

ARS will continue to use this research planning processes to integrate climate change into its research programs and will continuously adapt research objectives as customer and partner needs for climate research shift. For example, where ARS does certain research may change in response to climate. If crops or production systems becomes less viable in certain regions, or producers change what they grow, ARS can adapt its research focus in those regions accordingly. This process also offers an opportunity to address new issues that may be priorities in other federal agencies, such as use of agrivoltaics in production systems.

V. Special Topics

1. Environmental Justice

ARS is continuously exploring research opportunities to enhance outreach to disadvantaged communities (as defined by USDA 2501 guidelines), and is using the following examples to ensure its activities include underserved populations:

- Increase participation of faculty in minority-serving institutions in professional training related to clean energy, and climate change adaptation and mitigation through the ARS 1890 Faculty Research program. The 1890 Faculty Research Sabbatical Program (FRSP) allows faculty at 1890 land-grant universities to participate in a residency at an ARS lab to conduct research of mutual interest.
- Measure participation in the ARS Student Outreach Database in the following categories: HACU Students, Wallace Carver Interns, 1890 National Scholars, 1994 National Scholars, and CAPAL Interns.
- During its research planning process described in section IV.2, ARS seeks input from a diverse set of stakeholders, including from disadvantaged communities, to develop its research priorities and collaborations.
- ARS is working closely with other REE agencies to identify new ways to track agricultural research benefits for disadvantaged communities as part of the Justice 40 initiative.

2. Workforce Climate Literacy

Facilities: The following are examples of how ARS is integrating climate literacy into its facility planning and operation

- Following Design Manual 242.1 and P&P 134.2 for Energy, Water, and Sustainability. P&P 160 also includes topics of Environmental compliance and Pollution Prevention.
- The Facilities Division (FD) Safety, Health, and Environmental Management Branch (SHEMB) holds several monthly calls and has committees to exchange information among staff. Biosafety, Safety Awareness Month during February helps train personnel and share information. Training is recorded and published to the ARS intranet site.
- FD also observes Earth Day every year with an email blast to all of ARS about a subject such as Climate Hubs in 2021 and live demonstrations at various locations.
- Sponsoring staff to attend Energy Exchange, Federal Utilities Partnership Working Group (FUPWG), and International Institute for Sustainable Laboratories (I2SL) training on climate change and related subjects.
- Monthly Energy Awareness Conference Calls with informational presentations on a product, process, or requirement for the facilities or research community.
- Incorporating climate change related topics and priorities into performance plans.
- Publishing case studies of Biobased Success Stories and Energy Patriots, who are employees that accomplished a noteworthy energy, water, or sustainability action. One recognition example is Polly Goldman, who was selected for a FEDS Spotlight Recognition Award and recognized at the 2021 virtual Energy Exchange. The nomination read: *“Polly Goldman is a Biological Sciences Research Technician who studies plant pathogens and replacements for ozone-depleting Methyl Bromide fumigation in strawberry cultivation in Salinas, CA. She was active in the design process of the new LEED Certified Agricultural Research Technology*

Center. Polly is championing the 1.1-megawatt Salinas Solar ARS ESPC Energy Sales Agreement photovoltaic project. She seeks out energy- and water-efficient alternatives to high-impact equipment and processes such as ultra-low freezers, growth chambers, and irrigation and finds ways to encourage adoption at the Salinas lab.”

Research: ARS scientists are considered experts on the impact of climate change on agricultural production and how agriculture can adapt to climate change to maintain productivity. Therefore, ARS scientists are often invited by federal agencies, professional societies, and non-governmental groups to present their research and knowledge about climate related science. In this way, ARS contributes extensively to workforce climate literacy across the USDA. Specific examples of ARS involvement in workforce climate literacy include:

- Participating in planning, providing speakers for, and providing ARS employee access to the 2022 USDA-wide Climate, Agriculture, and Forestry Seminar Series designed to increase climate literacy across the USDA and Cooperative Extension workforce. The series focuses on the scientific foundation of climate change and its relationship to working lands.
- ARS locations are regularly conducting internal science update seminars for their staff and partners, including topics on climate science. One example is the US Dairy Forage Research Center’s monthly Webinar Series (<https://www.ars.usda.gov/midwest-area/madison-wi/us-dairy-forage-research-center/upcoming-events/upcoming-events/>)
- ARS Office of Communications mission is to inform the nation of the nature and progress of ARS research through a coordinated, multi-media approach. The Office has an Internal Communications Branch that is responsible for amplifying the role, missions, and successes of ARS to its current and alumni workforce through the delivery of information via internal communication platforms. <https://www.ars.usda.gov/oc/>.

3. ARS partnership with the USDA Climate Hubs

Along with US Forest Service and USDA Natural Resources Conservation Service, ARS helps to lead and host the USDA Climate Hubs. The Hubs are thus critical partners that enhance ARS capacity to enable climate-smart agriculture by making ARS research more regionally relevant, helping ARS respond regionally to USDA and interagency priorities, investing in priorities and outcomes through regional engagement of underrepresented groups, and training the next generation of climate-informed scientists.

The ARS Climate Hubs and ARS research units frequently and purposefully engage each other and seek opportunities to leverage resources to further enable collaboration. Recently, the ARS Climate Hubs were formally integrated into the ARS project portfolio to facilitate Hub engagement between the Hubs and ARS National Programs. ARS also participates regularly in Hub information dissemination, such as the Northeast Climate Hub Webinar [Series](#).

A key activity of the Climate Hubs is to identify regional climate vulnerabilities and risks. Through the Hubs partnership, ARS is using this Hubs information to develop the locally specific tools and resources that stakeholders need to help build climate change adaptation capacity. These resources are then disseminated through the Hubs. One example is the Grass-Cast model (<https://grasscast.unl.edu/>) that is featured by the Hubs and provides forecasts of rangeland

forage productivity in the Plains and Southwest to help producers adapt their cattle management to climate-driven conditions.

Table 1. Adaptation actions to address climate change effects and vulnerabilities

Climate Vulnerability	Action Title/Description	Type of Activity	Lead Office	Timeframe	Coordination	Progress Metrics	Accomplishments to Date
Impacts to research resources	Research locations and programs have a Continuity of Operations Plan (COOP) to continue critical operations during severe weather impacts.	Ongoing	5 ARS regional Area Offices	2022 and continuous	Internal to ARS	Plans developed and Action Items are tracked	
Impacts to research resources	Animal research facilities plan for animal welfare during extreme weather	Ongoing	Individual locations coordinated by Area Offices	2022 and continuous	Internal to ARS	Individual locations track their plans	
Impacts to research resources	All location Project Plans include a contingency plan for how experiments will be adapted in the event of extreme weather or climate	Ongoing	Individual locations coordinated by Area Offices and Office of National Programs	2022 and continuous	Internal to ARS	Individual locations track their plans	See individual location existing Project Plans
Impacts to Facilities	Continuity of Operations (COOP) plans to continue critical operations at ARS locations under a range of circumstances, including weather impacts	Ongoing	Individual locations coordinated by Area Offices	2022 and continuous	Internal to ARS	Individual locations track their plans	
Impacts to Facilities	Energy Sustainability follows 2020 Guiding Principles for Sustainable Federal Buildings and receiving certification from a 3rd party such as LEED or Green Globes.	Ongoing	Facilities Division	2022 and continuous	Internal to ARS		

Impacts to Facilities	Position facilities to have energy redundancy	Ongoing	Facilities Division	2022 and continuous	Internal to ARS	Compliance Tracking System	
Impacts to Facilities	Purchase or produce 7.5% of electricity consumption in renewables	Ongoing	Facilities Division	2022 and continuous	Internal to ARS	Compliance Tracking System	7 locations with photovoltaic arrays. Developed RFP for photovoltaic projects that won a Federal Energy and Water Management Award in 2019. 2 solar thermal projects that produce 42 million BTUs of energy annually. 1 open loop geothermal system that uses a plate and frame heat exchanger to precool chiller water.
Impacts to Facilities	Energy Storage	Ongoing	Facilities Division	2022 and continuous	Internal to ARS	Environmental Management System (EMS) plans	ARS has one net-zero electricity facility, and another just completed construction. Other photovoltaic energy projects are in procurement and under development. Geothermal energy is used at one location, and its use has been studied at two other locations. Two facilities have solar thermal hot water.
Threats to Property	Performs regular and preventive maintenance to keep buildings and equipment in optimal condition to resist and survive severe weather.	Ongoing	Facilities Division	2022 and continuous	Internal to ARS	Environmental Management System (EMS) plans	Incorporating proper structural design criteria into ARS' Design Manual P&P 242.1.

Threats to personnel	Implement and refine Health and Safety alerts and communications applications to keep personnel informed and safe during extreme weather events.	Ongoing	Individual locations coordinated by Area Offices	2022 and continuous	Internal to ARS	Individual locations track their plans	
Threats to Research Mission	Implement programs to ensure research is current with stakeholders needs for climate adaptation	Ongoing	Office of National Programs	2022 and continuous	Internal to ARS	Program Action Plans, Retrospective Review Reports, Location annual project reports	
Threats to Research Mission	Implement programs to promote collaborative research for climate adaptation	Ongoing	Office of National Programs	2022 and continuous	ARS, NRCS, University Partners	Project visioning documents and annual reports	Established the LTAR, GRACEnet, CEAP, REAP, Breeding Insights Platform research initiatives
Threats to Research Mission	Implement programs to promote innovative research for climate adaptation	Ongoing	Office of National Programs	2022 and continuous	Internal to ARS	Project Annual Reports	Established the ARSx, PDI, Grand Challenge Synergies programs
Workforce Climate Literacy	Integrate climate literacy into planning and operations	Ongoing	Location offices and Facilities Division	2022 and continuous	Internal to ARS		Safety, Health, and Environmental Management Branch (SHEMB) monthly calls. Biosafety, Safety Awareness Month
Workforce Climate Literacy	Integrate climate literacy into research mission	Ongoing	Location offices, Office of National Programs, Office Communications	2022 and continuous	internal and in coordination with USDA agencies as appropriate	Location and Office Planning	Locations hold regular research webinars. Numerous outreach products by Office of Communications.

