BUREAU OF RECLAMATION

Research and Development Office

Science and Technology

Research Program

2026 – 2029 Innovation Strategy



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U.S. Department of the Interior

Mission Statements

The U.S. Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, Native Hawaiians, and affiliated Island Communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Cover photo: A montage of outdoor scenes representing each of Reclamation's five regions.

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About this Strategy

The Bureau of Reclamation is the nation's largest wholesale water supplier, operating 296 reservoirs with a total storage capacity of 140 million acre-feet. It is also the second largest producer of hydropower in the United States and operates 53 hydroelectric powerplants that annually produced, on average, 37 billion kilowatt-hours for the last 10 years.

The mission of the Bureau of Reclamation (Reclamation) is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. As Reclamation carries out its mission, it encounters a variety of scientific and technical challenges that require innovation. Reclamation's Research and Development (R&D) Office administers the Science and Technology (S&T) Program, which invests in innovation that advances Reclamation's technical abilities to manage, develop, and protect water and related resources. The R&D Office works to efficiently, accountably, and responsively support innovation that addresses the full range of technical challenges confronting Reclamation water and power managers and their project stakeholders.

This S&T Innovation Strategy (Innovation Strategy) describes S&T Program elements and how they integrate to address Reclamation's mission-related scientific and technical challenges. It also describes the processes employed by the S&T Program to identify innovation priorities. Together, the synergy of program elements and attention to innovation priorities facilitate the development and adoption of high-impact solutions into operations.

This Innovation Strategy represents an update to the "Science and Technology Program – Innovation Strategy – FY2022 - FY2025" that has guided S&T Program project investments since Fiscal Year (FY) 2022. Like its predecessor, this document organizes innovation activities through a set of Research Areas and is complemented by annual implementation planning to respond to emerging needs and priorities. The Research Areas outlined in the FY2018 - FY2022 Science Strategy have remained consistent, demonstrating their continued effectiveness in representing the breadth of Reclamation's innovation needs.

This Innovation Strategy was updated through an internal iterative process with R&D Office staff and S&T Research Coordinators providing initial updates. Input was then sought from the S&T Regional Coordinators, Prize Competition leads, other Reclamation staff, and external partners from the water management and hydropower community.

Program Elements

In support of enhancing the delivery of Reclamation's mission, the S&T Program aims to:

- Develop cost-effective solutions for the technical and scientific challenges affecting the accomplishment of Reclamation's mission, while leveraging funds with other entities to advance research in a collaborative manner.

- Build and strengthen scientific and engineering capacity for Reclamation to advance the most relevant research and demonstration projects.

- Communicate solutions to Reclamation offices, other water and power management officials, and the public, and build partnerships with other water and power management agencies and stakeholders.

These objectives are carried out through six program elements grouped into two categories, those that generate solutions and those that advance, transform, or foster the use of solutions, as detailed below.

Solution Generation

- Research Program – Internally led research projects, sometimes with external expertise

- Prize Competition Program – Crowdsourced solutions for difficult challenges

- Snow Water Supply Forecasting Program – External grant program focused on snow monitoring related research and water supply forecasting

Solution Advancement & Adoption

- Technology Transfer – Partnerships with industry to mature and commercialize solutions

- Facilitated Adoption –Support for the transition of solutions into operational use

- Outreach and Dissemination– Sharing of research outcomes with stakeholders and the public to support innovation adoption

Together, these elements provide robust, comprehensive support of the innovation cycle from conception to implementation.

Research Program

The S&T Research Program funds research projects that are internally led and address the full range of science and technology challenges facing Reclamation water and power managers.

Identification and prioritization of research needs are guided by input from Reclamation end-users and informed by perspectives from partner agencies and stakeholders. The program invites research projects with a duration of one to three years, primarily through an annual internal research solicitation. Projects typically have strong cost-sharing and collaboration with Reclamation end-users, stakeholders, other agencies, and/or universities. Partnering enables Reclamation researchers to leverage external expertise to enhance project teams and likelihood of project success.

Research projects are organized by five Research Areas, which are broad, mission-oriented fields of study that span the scope of Reclamation's mission. The Research Areas were developed through an iterative internal and external process for the FY2018 - FY2022 Science Strategy and reviewed again in the FY2022 - FY2025 Innovation Strategy. These Research Areas have remained consistent over the past eight years, reflecting the continuing need to innovate across Reclamation's mission in these topical areas. Further, this consistency enables data-driven program management such as tracking trends in the types of projects funded.

The term "Research Category" is used to denote a particular topic within a "Research Area". For instance, the "Water Infrastructure" Research Area contains the following Research Categories: Dams, Canals, Pipelines, and Miscellaneous Water Infrastructure. "Research Needs" refer to specific lines of research meant to address a specific problem within a Research Category. An example of current Research Need within the "Dams" Research Category is to "investigate new methods to detect erosion in high-hazard dams".

Subject matter experts within Reclamation review the Research Areas every four years to ensure they are still relevant to the agency's mission. Research categories and needs are reviewed annually, and if necessary, updated for consistency with technical developments in the Research Area.

These Research Areas are described below.



Water Infrastructure (WI): Improve safety, reliability, and resiliency of Reclamation water storage and delivery facilities by developing or advancing solutions, tools, and practices that facility managers can use to cost-effectively maintain, modernize, or extend the life of Reclamation's infrastructure. These projects should be related to the operations and maintenance responsibilities of Reclamation facilities.



Power and Energy (PE): Improve safety, reliability, resiliency, and efficiency by developing or advancing operations and maintenance and regulatory compliance solutions, tools, and practices of Reclamation's hydropower, pumping, and pump-storage facilities. The objective is to reduce costs, increase energy supplies, and add value, thereby ensuring Reclamation's hydropower remains a long-term, cost-competitive energy resource within quickly changing energy markets.



Environmental Issues for Water Delivery and Management (EN): Improve the reliability of Reclamation water deliveries by producing effective solutions, tools, and practices that Reclamation water managers can use to carry-out Reclamation's mission in an environmentally sound manner.



Water Operations and Planning (WP): Develop solutions and tools that help Reclamation water managers make effective reservoir and river system operational and planning decisions. Improve the integration, evaluation, understanding, and presentation of critical data and information.



Developing Water Supplies (WS): Develop, enhance, and protect water supplies for Reclamation stakeholders with new technologies, solutions, and practices that expand, create, or conserve water supplies.

Research funding is awarded to employees throughout Reclamation, based on their proposal's relevance to Reclamation's mission and technical merit. Every proposal is reviewed by independent technical experts and then evaluated by a program panel that makes funding recommendations. After an internal red flag review, the funding recommendations are presented to the Washington Office for concurrence. See Reclamation's Directive and Standard RES 02-01 for additional information about S&T Program Research, Development, and Demonstration Projects processes.

S&T Research Program activities are supported by Research Area Coordinators, each of whom is a subject matter expert in one of the Program's Research Areas, as well as Regional Area Coordinators who represent one of Reclamation's five regions: California-Great Basin, Columbia-Pacific Northwest, Lower Colorado Basin, Upper Colorado Basin and the Missouri-Basin and Arkansas-Rio Grande Texas Gulf Regions.

Prize Competition Program

Reclamation utilizes prize competitions to harness the innovative capacity of the public and private sectors to solve problems related to Reclamation's mission and stakeholder interests through crowdsourcing. Prize competitions complement traditional research by providing an innovation tool that can find breakthroughs where research has stalled or has been overcome by technical obstacles or complexities. Prize competitions have a proven track record in the private sector for accomplishing game-changing results for both large and small problems. Agencies across the Federal government are successfully using prize competitions to spur innovation and advance on long-standing challenges.

Reclamation implements prize competitions through collaboration with other Federal agencies with common interests. This approach leverages complementary Federal capabilities, catalyzes inter-agency working relationships to solve joint problems, and leads to solutions that have a broader impact across the mission of multiple Federal agencies, our stakeholders, and overall public good.

Since the Prize Program's inception in 2015, multi-agency collaborations have been formed in three areas central to Reclamation's mission: water availability, infrastructure sustainability, and environmental compliance. These theme areas are well aligned with the S&T research areas of water infrastructure, power and energy, environmental issues for water delivery and management, water operations and planning, and developing supplies. Table 1 crosswalks the central prize competition theme areas with S&T strategic research areas. Moving forward, beginning with this Innovation Strategy, the prize competition program fully integrates and adopts the S&T research areas, aiding data-driven program management such as tracking trends in types of projects funded.

Prize Theme Area	S&T Research Area	S&T Research Category
Infrastructure	**Water Infrastructure (WI)**	• Dams • Canals • Pipelines • Miscellaneous Water Infrastructure
Infrastructure	**Power and Energy (PE)**	• Hydro Powerplants • Pumping Plants
Environment	**Environmental Issues for Water Delivery and Management (EN)**	• Water Delivery Reliability • Invasive and Nuisance Species • Water Quality* • Sediment Management • River Habitat Restoration
Water	**Water Operations and Planning (WP)**	• Water Supply and Streamflow Forecasting • Water Operations Models and Decision Support Systems • Open Data* • Hydrologic Variability
Water	**Developing Water Supplies (WS)**	• Water Treatment • Water Supply Augmentation • Groundwater Supplies • Agricultural and Municipal Water Supplies • System Losses

Table 1 - Relationships between Research and Development Office Prize Theme Areas, S&T Research Areas and Categories

Identification and prioritization of innovation topics that fit the prize competition structure paradigm are developed with input from Prize Competition theme area coordinators, Reclamation end-users, and informed by perspectives from partner agencies and stakeholders. Promising topics are developed further, circulated for internal red flag reviews, and concurrence from the Washington Office is sought prior to initiating new prize competitions.

Prize competitions can range from small, single stage, crowd-sourcing competitions with smaller prize purses to large multi-stage competitions with prize purses of several hundred thousand dollars or more. Prize competitions can also yield additional questions or identify new research gaps that will require development before demonstration at Reclamation. The S&T Research Program can be a logical next step to address identified gaps from prize competitions or solutions, including developing innovative technologies with low technology readiness levels. On the other hand, promising prize competition solutions can demonstrate readiness through other S&T Program elements to continue to advance, demonstrate, or adopt successful research outcomes.

Snow Water Supply Forecasting Program

The Snow Water Supply Forecasting Program (SWSFP) was established by the Snow Water Supply Forecasting Program Authorization Act of 2020. The Program is designed to advance emerging technologies to enhance snow monitoring and subsequent water supply forecasts. The program involves external grants and partnerships with federal, state, and local water management and forecasting agencies. While the SWSFP is primarily an external funding opportunity, snow monitoring and forecasting technologies advanced by these externally led research projects provide opportunities for other S&T Program elements to continue to advance, demonstrate, or adopt successful research outcomes.

Solution Advancement & Adoption

Technology Transfer

Reclamation's Technology Transfer activities through the S&T Program pursue a variety of joint venture research partnership agreements with the private sector, including Cooperative Research and Development Agreements (CRADAs), Materials Transfer Agreements (MTAs), and Facility Use Service Agreements (FUSAs). In these agreements, industry plays a key role in maturing and transforming research results into useable, manufactured products that can be supplied to Reclamation and the broader water management community. In addition, Reclamation uses Federal technology transfer authorities to protect Federal inventions and licenses them to U.S. industry, which creates jobs and helps U.S. industry better compete in global markets.

Facilitated Adoption Program

Completed S&T research projects and prize competitions yield promising solutions that stand to improve Reclamation's operations. However, often the results of a S&T research project or prize competition solution are not ready to fully integrate into Reclamation processes, and a demonstration of the technology is often key for integration into Reclamation practice. The Facilitated Adoption Program provides funding to lead researchers and facilities interested in piloting or demonstrating results from successful S&T research projects and prize competitions. Staff interested in demonstrating promising research projects or prize competition solutions through the S&T Facilitated Adoption Program submit a short statement of interest in response to the annual solicitation. These proposals are reviewed by S&T Research Area Coordinators, and the most promising submissions are invited to make pitch presentations to an independent panel of Reclamation staff. Projects recommended for funding also go through an internal red flag review

and Washington Office concurrence prior to announcing selected projects.

Dissemination of Research Results

Dissemination of the results of research projects targets a wide audience of Reclamation end-users, stakeholders, and others across the Federal and non-Federal water resources community. Broadly, this is accomplished through publication and open access to data and results, development of outreach materials and researcher recognition, public affairs channels, and various workgroups. The R&D Office assures the quality of disseminated innovation data, products and scientific information through compliance with Reclamation's Peer Review Policy.

The R&D Office utilizes a contemporary knowledge management system to support research dissemination called the Reclamation Information Sharing Environment, or RISE. At the end of a research project, the Lead Researcher must complete a report that documents the results of the project. The S&T Program then posts these final reports on RISE, along with key datasets in a common, machine-readable format, as required by the Open Government Data Act, Pub. L. No. 115–435 (2019).

In addition, the S&T Program conducts outreach using a variety of communications mediums. The "Knowledge Stream" magazine provides Reclamation staff and stakeholders updates on R&D Office efforts, which often include ongoing or completed research projects. Every year, the S&T Program publishes summaries for each Research Area to highlight complete, continuing, and new research projects. To highlight the Program's most successful completed projects, Program staff nominate an outstanding project in each of the Research Areas to complete for recognition as "Project of the Year".

Dissemination also occurs in partnership with public affairs. This may include promoting new, ongoing, or completed projects through press releases, news stories, or social media posts. Webinars, presentations, and the Knowledge Stream are also mechanisms for disseminating the prize competition winning solutions.

The S&T Program utilizes existing internal and external workgroups, committees, conferences, and councils as forums to share results. These groups foster technology uptake to meet needs and challenges while also encouraging new, fruitful collaborations. This includes coordination with Reclamation's Communities of Practices (CoPs), which aim to promote professional excellence, align Bureau-wide initiatives with current policy and legislative priorities, and provide strategic coordination across regions and directorates.

Integration of Program Elements to Implement Innovation Activities

This Innovation Strategy broadly guides investments within all S&T Program elements in a synergistic fashion. Program elements are designed and implemented to address all steps of the innovation process, from the formulation of initial concepts to the implementation of operational solutions. This section describes how program elements are integrated together to complement the overarching Research Areas, resulting in the implementation of innovation activities into Reclamation practice.

The S&T Program offers a range of program elements to support the development of mature solutions once research needs are identified. The determination of which program element is used to further an innovation activity is case-by-case and involves the coordination of program administrators, coordinators, subject matter experts, and the R&D Program Manager. In certain instances, an individual program element may be employed; in other situations, a combination of program elements may be implemented. Each S&T Program element is complementary and can work in tandem to address an innovation need and further the solution for adoption (Figure 1).

For instance, if an innovation activity begins with a research project, the insights gained can inform the design of a prize competition or be applied through facilitated adoption or technology transfer. Conversely, if the activity starts as a prize competition, it may identify promising solutions that require further development through research, or if the solutions are more mature, it can be implemented via facilitated adoption or technology transfer.

This approach for integrating multiple elements ensures that innovation solutions are supported at every stage, from concept to implementation. By leveraging the strengths of each program element, the S&T Program maximizes its ability to deliver impactful, mission-aligned solutions.

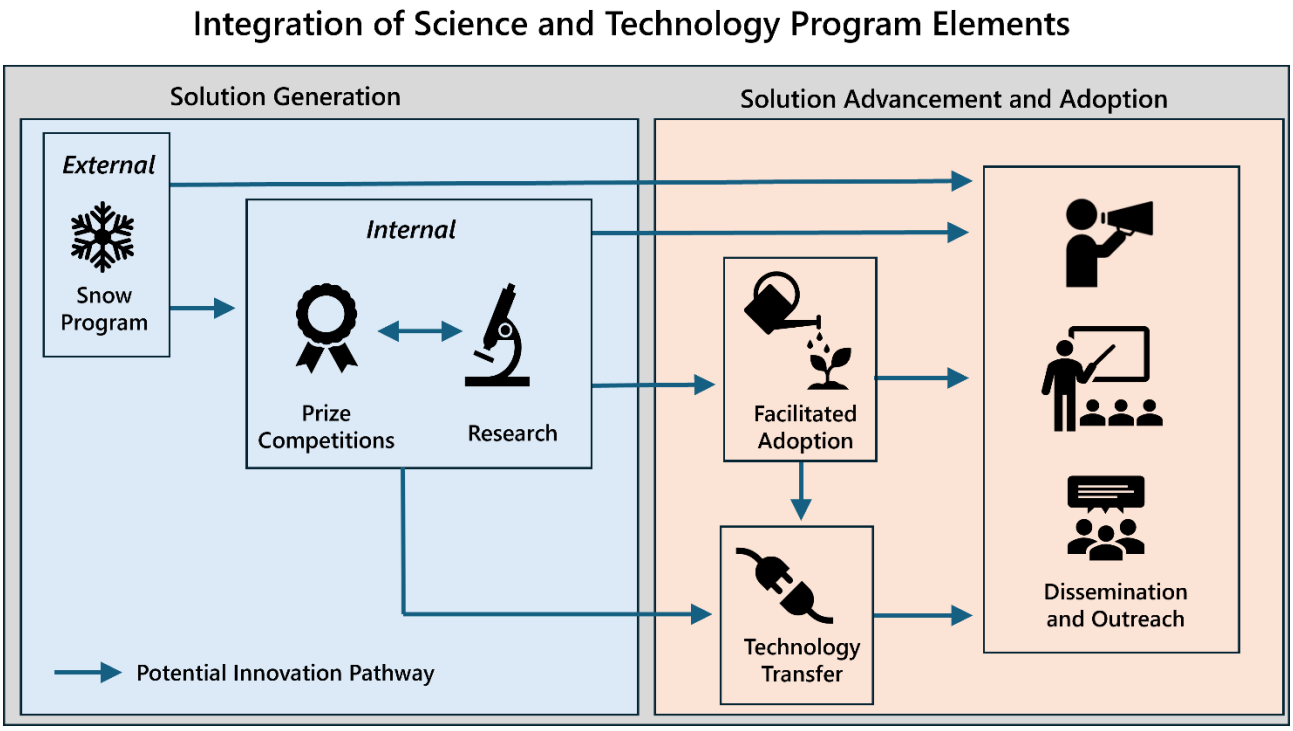


Figure 1 Science and Technology Program elements and potential innovation pathways

Innovation Needs

The S&T Program uses multiple approaches to ensure innovation needs and priorities reflect the current state of technical practices and administration priorities. This includes engaging Reclamation leadership, seeking input from subject matter experts across Reclamation, and maintaining dialogue with external partners.

Innovation Strategy Implementation Plan

Each year, the S&T Program updates the Innovation Strategy Implementation Plan (ISIP), which communicates Program needs and priorities for a given year. This document promotes both administration priorities and technical needs. Regarding the former, the S&T Program invites administration leadership to identify and refine priorities in the ISIP. For technical needs, the Program relies on subject matter experts in the Research and Development Office and the Technical Service Center to refine categories within each Research Area and identify technical needs for those categories (See Figure 2). Consistent Research Areas across years provide stability in support of program administration, while research categories and needs provide granularity and specific needs. This process offers agility to address changing priorities, emerging needs, or accomplishments from previously funded work. The ISIP is primarily highlighted in the annual call for research proposals but also informs the plan for near and long-term prize competitions through coordination across program elements.

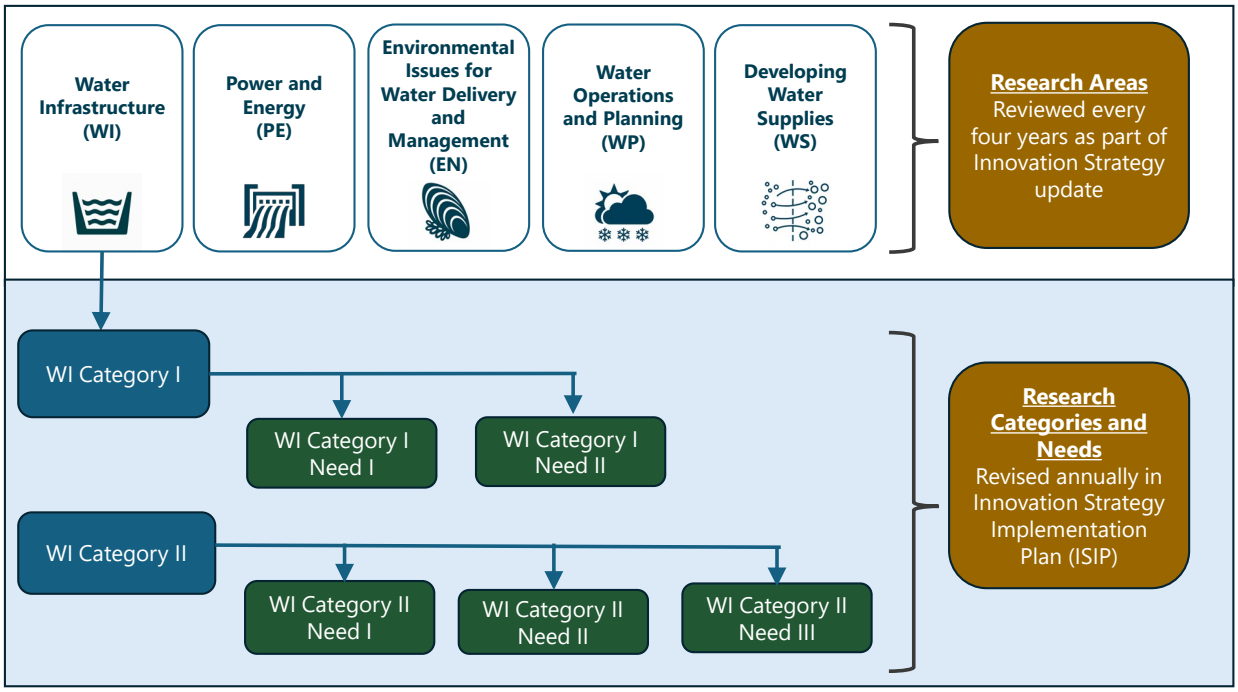


Figure 2 - Science and Technology Program Research Area, Category and Need relationships and revision frequency

Reclamation Director Needs

To complement the ISIP, the S&T Program also works to promote and prioritize internal leadership needs. To accomplish this, the Program annually engages Reclamation Directors (RD) to solicit their most pressing innovation needs and technical challenges. This process is facilitated by S&T Regional and Research Coordinators. Once identified, needs are collated and summarized in an RD Needs document. This document is primarily promoted through the annual S&T Research call for proposals but also seeds potential S&T Prize Competition activities.

Research Road-mapping

Research road-mapping is a strategic planning tool used to identify long-term innovation pathways that require sustained, multifaceted investment on focused topics. Roadmaps are developed as needed, often in response to emerging topics or when additional guidance is required to advance progress on a specific subject. The S&T Program develops these roadmaps in collaboration with internal and external subject matter experts to prioritize research needs and guide future efforts. Each roadmap is documented formally and serves as a reference for both annual planning and long-term strategy.

Internal and External Coordination

Internal and external coordination efforts play a major role in the ISIP, RD Needs, and research road-mapping processes. In addition, these coordination efforts can inform other S&T efforts and investments, by identifying needs and opportunities.

The S&T Program maintains regular coordination with internal partners through direct communication and collaboration with complementary programs. Research coordinators and prize competition theme leads serve as technical experts, helping to identify innovation needs and recruit subject matter experts to support research need identification, solution development, and implementation.

Externally, the Program collaborates with Federal, State, and local partners to identify shared research priorities. A key example is the partnership with the U.S. Army Corps of Engineers (USACE), formalized in 2014, which supports joint research in infrastructure sustainability, ecohydraulics, invasive species, and reservoir operations. This partnership includes an annual meeting to align research needs and opportunities. The Program also works closely with Bonneville Power Administration (BPA), Western Area Power Administration (WAPA), and the Department of Energy (DOE) to address innovation needs in power and energy and water infrastructure.

S&T activities regularly engage leading academic institutions in order to build project teams with the necessary expertise. Notably, Reclamation is a member of several Cooperative Ecosystems Studies Units, or CESU's. CESU's operate under a Cooperative Joint Venture Agreement between universities, non-profit organizations and Federal agencies that collaborate on natural and cultural resources issues in an ecosystem context. Each CESU focuses on a particular biogeographic region of the United States. They facilitate collaboration by offering Federal agencies a significantly reduced overhead rate when collaborating with universities that are member of the same CESU.

The Program is also active in private industry networks that focus on innovation in the water resources sector to survey emerging technologies and solutions being explored in the private sector. For example, the Program participates in activities of the Center for Energy Advancement through Technological Advancement (CEATI). CEATI is a user-driven, international network that supports the electric power industry through collaborative research, knowledge exchange, and technology development.

Special Emphasis: Artificial Intelligence

Recent advances in artificial intelligence (AI) crosscut nearly all aspects of Reclamation's mission. AI represents a transformative, crosscutting technology for Reclamation, with the potential to significantly enhance the agency's ability to manage, develop, and protect water and related resources. The S&T Program will prioritize research, development, and implementation of AI tools and methods to address complex challenges across all Research Areas: water infrastructure, power and energy, environmental management, water operations and planning, and developing water supplies. By leveraging AI for data analysis, predictive modeling, decision support, and automation, Reclamation can improve operational efficiency, optimize resource allocation, and strengthen resiliency. Annual implementation planning will identify priority needs for AI research and deployment, ensuring responsiveness to emerging opportunities and challenges. Through these efforts, Reclamation will position itself at the forefront of digital innovation in water resources management.