U.S. DEPARTMENT OF ENERGY

2021 Climate Adaptation and Resilience Plan

Report to the White House
National Climate Task Force and
Federal Chief Sustainability Officer
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Cover photo credits (left to right): TOP ROW - Thunderstorm near Cuero, TX [Lance Cheung, United States Department of Agriculture (USDA)]. MIDDLE ROW - Western Area Power Administration's tower after a storm [WAPA], Camillo Fire in Coconino National Forest [Liza Simmons, USDA Forest Service], inundated oil distribution equipment [DOE/Strategic Petroleum Reserve]. BOTTOM ROW - Selective undergrounding of overhead power lines [Consolidated Edison Inc.], National Renewable Energy Laboratory's 1.5MW wind turbine behind a 450kW photovoltaic array [NREL], elevated substation [Entergy Corporation].

I. Climate Adaptation Policy Statement

This Climate Adaptation Policy Statement affirms the Department of Energy's (DOE) commitment to lead by example in Federal efforts to manage the short and long-term effects of climate change on the Department's mission, policies, programs, and operations. It also reaffirms the Department's goal to address the challenges in President Biden's Executive Order (E.O.) 14008 *Tackling the Climate Crisis at Home and Abroad*, as well as the focus on identifying the physical risks from climate change across government operations in Executive Order (E.O.) 14030, *Executive Order on Climate-Related Financial Risk*, by making climate adaptation and resilience an essential element of the work the Department does.

The mission of DOE is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions. DOE works on the frontiers of scientific understanding and technical innovation to address the impacts of climate change by researching, developing, and deploying innovative and promising sustainable and resilient clean energy technologies.

DOE understands its mission is performed in an already changing climate. The Fourth National Climate Assessment reports that the nation will increasingly experience more frequent, intense, and longer duration extreme weather events across all regions of the country, including extreme temperature and precipitation events, stronger hurricanes and storm surge, and droughts and wildfires. The National Oceanic and Atmospheric Administration (NOAA) reports that damage costs are already significant. The year 2020 set an historic record, with 22 separate events each costing over a billion dollars in damages, and a cumulative cost exceeding $95 billion dollars. For far too long, communities of color and low-income communities have borne the brunt of pollution to the air, water, and soil they rely on to live and raise their families; and under-served communities across the U.S. will be the hardest hit by climate impacts like extreme weather events. The transition to a clean economy must lift up these communities that have been left behind, and make sure those who have suffered the most are the first to benefit.

DOE remains committed to taking every available action to mitigate greenhouse gas (GHG) emissions to reduce the impacts of climate change. Further, we understand that we must adapt to these impacts and increase departmental resilience. Sustaining DOE's mission in this changing environment is dependent on DOE's ability to successfully identify aspects of climate change likely to impact its mission and operations, as well as its ability to respond strategically.

DOE will lead by example to achieve the President's mandate to both mitigate and adapt to climate change by setting ambitious goals, developing aggressive plans, and acting with urgency to execute those plans. The Department's plans will be informed by the best science and technical information to effectively translate these into actions. Climate change adaptation is a crucial component of a comprehensive response to climate change and DOE will – through this plan – develop approaches that ensure its mission, programs, policies, and operations remain effective for the American people in current and future climate conditions. In addition, the DOE Sustainability Plan will outline actions DOE will take to mitigate climate change through emissions reductions.

The Department's climate actions support the President's goals, including those articulated in E.O. 14008. The Department's approach will comprise of several adaptation strategies, such as reducing energy demand and increasing energy efficiency, increasing site and grid hardening and modernization, and enhancing the deployment of microgrids, distributed energy resources, and storage. In addition, sites and offices will conduct climate vulnerability assessments and develop resilience plans no later than one year from issuance of the Climate Adaptation and Resilience Plan and update these documents at least every four years.

The Department's adaptation and resilience path forward will be shaped by the following guiding principles:

- Protecting DOE assets from climate change impacts by assessing its vulnerabilities, taking action to adapt to the changing environment, and making resilience a cornerstone of operations to ensure DOE has climate-ready sites.
- Using the scientific expertise and world-class research and development capabilities of DOE's National Laboratories to demonstrate promising adaptation technologies at DOE sites.
- Partnering with local communities so we may share in the benefits of DOE's climate adaptation, resilience, and energy and environmental justice initiatives.
- Leveraging DOE's purchasing power in collaboration with other Federal agencies to spur innovation, identify and reduce climate-related financial risk, enhance resilience, and expand the market for U.S. manufactured sustainable products and services, and promote well-paying union jobs on the path to a clean energy economy.

In addition to these guiding principles, the Department commits to implementing the performance goals and actions that are included in the Department's Climate Adaptation and Resilience Plan, and the Sustainability Plan which will be issued in the future. The Department will incorporate these actions, guiding principles and goals in our planning, operations, and budget processes, including where appropriate, identifying opportunities to realign resources and needs for new resources.

Furthermore, the Department will engage and share best practices with other Federal agencies through the National Climate Task Force, interagency working groups, and by joining or forging new collaborations with other agencies and stakeholders, as appropriate. DOE will continue to leverage its unique modeling, climate science expertise, policy, and engineering capabilities in collaboration with other agencies and institutions, to continuously improve our adaptation and resilience strategies. The Climate Adaptation and Resilience Plan will be updated as needed to capture new understandings and any mission changes in order for the Department to effectively address the climate crisis.

I am designating Ingrid Kolb, DOE's Chief Sustainability Officer as the senior level official responsible for coordinating implementation of the Climate Adaptation and Resilience Plan, and directing the Sustainability Steering Committee (SSC), comprised of senior leaders from the DOE program and staff offices, to coordinate implementation of this policy, identify and propose solutions to barriers, and provide any necessary guidance. Quarterly updates on our progress will be provided to DOE senior leadership.

08/25/21

Jennifer Granholm
Secretary of Energy

Date

II. Introduction

DOE recognizes that our country and the world are facing a climate crisis. DOE's mission of ensuring America's security and prosperity by addressing energy, environmental, and nuclear challenges through transformative science and technology solutions is vital to the nation's economic and national security. As outlined in E.O. 14008, *Tackling the Climate Crisis at Home and Abroad*, this Climate Adaptation and Resilience Plan, and Climate Adaptation Policy Statement build upon prior DOE actions taken to bolster adaptation and increase the resilience of DOE facilities and operations.

DOE works on the frontiers of scientific understanding and technological innovation to reduce GHG emissions and mitigate the impacts of climate change by researching, developing, and deploying innovative and promising clean energy technologies. With approximately 50 active sites, DOE has a variety of missions including environmental cleanup, scientific research and development, national nuclear security, power marketing, and more. DOE can only succeed in its mission if it can successfully identify risks, hazards, and vulnerabilities from climate change that have the potential to impact operations, as well as effectively define and implement appropriate adaptation and mitigation actions.[1]

This plan addresses both climate adaptation and mitigation, which are complementary actions necessary for DOE to become more resilient, adapt to a changing climate, and reduce GHG emissions. This forward-looking plan identifies and prioritizes the Department's adaptation and resilience efforts to ensure DOE continues to achieve its mission. The actions described in this plan apply to all programs and facilities and will be updated as needed to capture any mission changes and reaffirm the Department's commitment to address the climate crisis.

DOE has identified five priority adaptation actions in this plan: (1) Assess Vulnerabilities and Implement Resilience Solutions at DOE Sites, (2) Enhance Climate Adaptation and Mitigation Co-benefits at DOE Sites, (3) Institutionalize Climate Adaptation and Resilience Across DOE Policies, Directives, and Processes, (4) Provide Climate Adaptation Tools, Technical Support, and Climate Science Information, and (5) Advance Deployment of Emerging Climate Technologies. In addition, this plan describes DOE's current and planned actions for the following specific topic areas: (1) Climate Vulnerability Assessments, (2) Climate Literacy in DOE's Management Workforce, (3a) Climate Resilience for Climate-Ready Sites and Facilities, and (3b) Climate-Ready Supply of Products and Services. The Department commits to incorporate these actions into our planning, operations, and budget processes, including where appropriate, identifying opportunities to realign resources and needs for new resources.

DOE has designated DOE's Chief Sustainability Officer as the senior level official responsible for coordinating implementation of the Climate Adaptation and Resilience Plan. The designee will work with other senior level officials within each organization and influence the Department's top priorities to ensure that all actions detailed in this plan are implemented. They will also coordinate with the White House Federal Chief Sustainability Officer, Interagency Environmental Justice Working Council, Interagency Sustainability Working Group, and others as appropriate to assist in the planning of and

[1] The DOE Climate Adaptation and Resilience Plan addresses adaptation, and emissions mitigation actions that have adaptation and resilience co-benefits. In addition, the DOE Sustainability Plan will outline actions that the Department will take to mitigate climate change through emissions reductions.

reporting on DOE's climate-related actions. DOE will submit annual progress reports on implementation efforts to the National Climate Task Force and the Federal Chief Sustainability Officer.

III. Priority Adaptation Actions

This section of the plan provides a description of DOE's five priority actions including implementation, methods, challenges, timeline, and examples. Through the implementation of these priority actions throughout DOE's mission, programs, operations, and management of procurement, real property, public lands and waters, and financial programs, DOE will strive to ensure that climate change adaptation and resilience is achieved Department-wide.

PRIORITY ACTION 1: Assess Vulnerabilities and Implement Resilience Solutions at DOE Sites

Taking a proactive approach to climate change adaptation and resilience, DOE will reevaluate its vulnerability assessment processes, conduct and update site-level assessments, as well as develop and implement resilience plans. In this effort, each DOE site will identify its vulnerabilities by utilizing the latest climate science data and consulting stakeholders, and as needed develop resilience solutions that will roll up to the Departmental level to inform resource allocation and decision-making. This process will not only create a more climate resilient and adaptive Department but will in some cases enhance the resilience of neighboring communities.

IMPLEMENTATION METHODS

Review and Conduct Vulnerability Assessments: DOE will continue its efforts to understand potential climate-related impacts on its mission and operations and develop a framework to standardize the vulnerability assessment process. Thus far, DOE has completed screenings and assessments at 51 percent of sites. For instance, the Office of Legacy Management (LM), which performs long-term surveillance and maintenance of over 100 prior Manhattan Project and Cold War nuclear legacy sites in 36 states, is working with Lawrence Berkeley National Laboratory (LBNL) to perform a comprehensive analysis of climate change impacts and design/sustainment strategies to mitigate these impacts. LM's understanding of climate change risks and mitigation strategies related to its long-term mission is essential for the protection of current and future LM sites as well as the minimization of DOE's long-term environmental liability.

As noted in the Climate Adaptation Policy Statement, Program Offices will be required to conduct or update assessments and develop resilience plans at their respective sites within one year of issuance of the Climate Adaptation and Resilience Plan. These assessments and plans will be revised on at least a four-year cycle to include updated information, such as data from the latest National Climate Assessment (NCA). The Office of Asset Management's Sustainability Performance Division (SPD) will monitor progress and report to the lead Climate Official, Chief Sustainability Officer, and SSC.

To conduct vulnerability assessments, sites should utilize DOE's 2021 Vulnerability Assessment and Resilience Plan (VARP) guidance and related guidance such as DOE's 2017 screening guidance, *Climate Change Vulnerability Screenings* and 2015 assessment guidance, *Practical Strategies for Climate Change Vulnerability Assessments*. SPD will provide technical assistance during the assessment process, and at the end of this cycle of assessments, will update the guidance documents based on program feedback, including the incorporation of lessons learned. Throughout this process, SPD will work closely with the Program Offices to enable continuous learning by identifying common challenges and potential cost-effective resilience approaches, and sharing best practices and lessons learned.

Within the VARP process, sites will account for a range of climate hazards for which they may be at risk. Detailed vulnerability assessments will consider multiplier effects (e.g., wildfires creating more hydrophobic soil) from compounding threats and the extent that vulnerabilities affect mission critical functions and operations. Assessments will be integrated with other site or laboratory planning documents, procedures, and policies. Throughout this process sites will evaluate the potential costs and consequences of inaction, both to DOE sites and external communities, including the assessment of energy and environmental justice communities' impacts. Sites will leverage community partnerships with utility providers, neighboring municipalities, external emergency response entities, tribal stakeholders, and others.

Plan, Prioritize, and Implement Resilience Solutions: As part of the VARP process, Program Offices and/or sites will develop resilience plans that identify site level resilience solutions. Resilience solutions should prioritize implementation by considering the number of key vulnerabilities mitigated, mission impact, and capital and operational costs and savings. For example, the Strategic Petroleum Reserve (SPR) conducted a Risk and Resilience Assessment that included an analysis of identified resilience solutions such as elevating equipment vulnerable to storm surge flooding, and SPR linked these vulnerabilities to their Life Extension – Phase II project, which supports actions to extend key equipment and infrastructure capabilities for another 25 years.

DOE sites continue to deploy a variety of resilience solutions addressing a range of climate threats. For example:

- Bonneville Power Administration (BPA) and Western Area Power Administration (WAPA) have developed Wildfire Mitigation Plans to address the risk of wildfires in the Pacific Northwest, Western, and Midwestern United States on electricity transmission lines they operate. These resilience plans help BPA and WAPA prepare and proactively manage the vegetation on their rights-of-way as well as monitor and maintain equipment to mitigate wildfire risks.
- The Office of Environmental Management (EM), which addresses the nation's Cold War environmental legacy through the largest environmental clean-up program in the world, is working to modernize the Savannah River Site's (SRS) electrical distribution system to improve resilience to power outages from extreme heat and storm events by updating and building more resilient transformers and associated equipment, insulator upgrades, pole replacements, grounding, transmission lines, and support towers.
- EM also worked with the Hanford Site on integrating procedures that call for work/rest protocols for extreme heat, limited off-road vehicle use during red flag days, and alert systems for storms/high wind events. The Hanford Site also continues to plant wildfire-tolerant vegetation and fire barriers, including adding firebreaks and performing additional dry tinder removal.
- The Office of Nuclear Energy (NE), which advances nuclear science and technology, is addressing threats of increased drought and higher summer temperatures at Idaho National Laboratory (INL) by undertaking major renovation efforts for laboratories to reduce energy usage by modernizing HVAC control systems and replacing old constant air volume hoods with variable air volume hoods. These efforts improve control of the pressure and temperature within each of the lab spaces, which enhances energy savings and personnel safety.
- The Office of Fossil Energy and Carbon Management (FECM), which is responsible for research and development of programs involving carbon-based fuels, direct air capture, and carbon

capture and storage, is addressing the issues of energy and water resilience at its National Energy Technology Laboratory (NETL) through a variety of solutions including cooling tower renovations, boiler and chiller replacements, lighting upgrades, electrical vehicle charging stations expansion, and building upgrades for energy efficiency. With sites in Oregon, West Virginia and Pennsylvania, NETL operations are potentially vulnerable to a range of climate threats including drought, heat waves, and intense storms that can impact electricity demand and supply.

- The National Nuclear Security Administration (NNSA) is modernizing its infrastructure to be more resilient and to provide the capabilities and capacities for meeting the national security mission. Achieving this requires an array of complementary strategies including construction, short-term leases, and timely disposition of excess facilities. Revitalization efforts, energy efficiency measures, and standardized designs that incorporate resilience measures that address threats to NNSA's national security mission.
- The Office of Energy Efficiency and Renewable Energy's Water Power Technologies Office (WPTO) enables research, development, and testing of emerging technologies to advance next-generation hydropower and pumped storage systems for a flexible, reliable grid. WPTO, in coordination with Oak Ridge National Laboratory (ORNL) and Pacific Northwest National Laboratory (PNNL), oversees the development and release of an assessment and report to Congress in examining the potential effects of climate change on water available for hydropower at Federal facilities. WPTO's 9505 Secure Water Analysis (SWA) is a response to Section 9505 of the SECURE Water Act of 2009 (*Omnibus Public Lands Act, Pub. L. No 111-11, Subtitle F*), which requested that the Department assess the effects of and risks from global climate change on water supplies for Federal hydroelectric power generating and marketing practice of the Federal Power Marketing Administrations (PMAs). WPTO is currently conducting a third nationwide assessment—on both the PMAs and non-Federal hydropower entities—to effectively develop tools that bridge climate science to actionable system intelligence. This study aims to assess future vulnerability and risk from drought, decreased snowpack, elevated river temperatures, and flooding. In the future, this work will form a baseline climate assessment to inform climate resilient Federal hydropower.

The Office of Sustainable Environmental Stewardship, within DOE's Office of Environment, Health, Safety and Security, will continue to partner with SPD, the Program Offices, and sites to develop a sustainable and climate-ready sites initiative to recognize DOE sites that demonstrate leadership by improving performance in natural resource management, climate adaptation, resilience, and sustainability.

CHALLENGES & RISKS

DOE recognizes the importance of implementing resilience solutions to ensure that the Department can continue to fulfill its mission. DOE has a wide variety of sites located in varying geographic locations, each with a unique set of missions and environmental considerations. Some unique mission facilities may have safety requirements and operational demands that could complicate implementation of resilience solutions and will require further analysis to ensure optimal operations under changing climate conditions.

Many sites may not have staff with the knowledge to conduct an in-depth climate vulnerability assessment and develop resilience plans. To address gaps, DOE will provide technical guidance and

support, advance climate literacy training, and use the best available tools to identify cost-effective resilience solutions. DOE has a well-established hazard assessment and adaptation process focused on its high-hazard nuclear facilities. This process ensures that the most critical facilities are well protected from climate risks, but this formal hazard assessment process is complex and costly. A challenge for DOE is leveraging its existing, robust system to improve the implementation of tailored risk adaptation and resilience across the Department. Another risk is the challenges of implementing resilience solutions. To address this, DOE will integrate the implementation of resilience solutions into the budgeting and contracting processes and assess the performance of deployed solutions to inform decision-making.

Conducting assessments, updating DOE guidance documents, and identifying and implementing resilience solutions will require thoughtful and strategic budgeting for resources. While DOE recognizes that the upfront cost of planning for and implementing resilience solutions may prevent future costs from climate-related damage, the execution of these activities is dependent on existing budgeting and contracting processes. DOE sites are primarily government owned and contactor operated through complex management and operations contracts. Within available resources, sites and operations deemed critical to DOE's mission and national security will be given priority.

PERFORMANCE TRACKING & COORDINATION

Initial metrics include characterizing presence or absence of climate hazards (e.g., coastal flooding, riverine flooding, heat, drought, land degradation, wildfire, and historical extreme weather events). Metrics will also measure whether site vulnerability assessments have been performed and if results are incorporated in planning, including site resilience plans. The Program Offices will be responsible for ensuring the quality of assessment processes and resilience plans at their sites and SPD and the Office of Sustainable Environmental Stewardship will provide technical assistance, as needed. SPD will track the percentage of sites that complete vulnerability assessments and resilience plans. Additionally, DOE sites and programs will track the implementation of resilience solutions as identified in the resilience plans. SPD will report on appropriate metrics to the lead Climate Official, the Chief Sustainability Officer, and SSC. Throughout the assessment and implementation process, DOE will coordinate with other Federal agencies to identify and share resilience solutions, lessons learned, and best practices. DOE will coordinate with tribal, state, and local governments, as well as other partners to plan and implement resilience solutions that may affect neighboring communities.

PRIORITY ACTION 2: Enhance Climate Adaptation and Mitigation Co-benefits at DOE Sites

DOE recognizes that climate change mitigation is a crucial complement to adaptation and resilience to successfully meet its research, environmental management, and nuclear security missions. The more that can be done to reduce GHG emissions, the less adaptation will be required. Many adaptation and resilience actions have mitigation co-benefits. For example, the deployment of renewable energy resources, such as solar photovoltaic electric systems, in combination with microgrids and storage can reduce vulnerabilities from power outages, while also reducing GHG emissions. Similarly, reductions in energy demand for site operations reduces vulnerability to reductions in power supply from extreme storm events, droughts and wildfires, and other climate risks, but also reduces GHG emissions. DOE will need to pursue a dual climate strategy that leverages the co-benefits of adaptation and mitigation actions, and ensures its mission, programs, policies, and operations remain effective in current and future climate conditions.

DOE is committed to leverage the co-benefits of adaptation and mitigation actions to both enhance resilience and achieve net-zero GHG emissions. DOE will accomplish this through comprehensive operational planning, implementation of strategic projects, use of DOE procurement mechanisms to purchase low carbon footprint products, and ongoing monitoring of progress. 85 percent of DOE's Scope 1[2] and 2[3] GHG emissions are from energy use in facilities and the rest are from industrial processes, fugitive sources, and fuel use in fleet vehicles and equipment. Plans to manage these sources will drive operational changes as well as resource allocation across DOE. Adaptation/mitigation strategies include reducing energy and water use, transitioning to clean on-site energy sources and microgrids, electrifying DOE's fleet and facilities, reusing on-site water resources, and managing DOE lands and property to retain water and preserve carbon-storing vegetation, enhancing the use of green infrastructure, and minimizing risk to energy transmission, distribution, and support systems.

In addition, DOE will pursue enhanced electrification in an integrated manner with other objectives such as improving site and grid resilience. Furthermore, DOE will identify approaches to enhance electrification with carbon pollution-free electricity while also decreasing energy use and reducing GHG emissions. DOE's planning efforts will account for both current conditions and evolving future conditions due to climate change. Within one year, the Program Offices will prioritize energy efficiency and identify net-zero emission on-site projects.

IMPLEMENTATION METHODS

DOE has already reduced its Scope 1 and 2 GHG emissions by 52 percent from FY 2008 through aggressive energy management and has identified further opportunities for the reduction of Scope 1, 2, and 3 emissions. DOE will focus on four key implementation strategies to enhance climate adaptation and mitigation efforts.

Reduce Energy and Water Use in Facilities: To carry out facility related energy and water reductions, DOE will take a strategic approach that includes optimizing DOE's facility footprint to support a flexible workforce, prioritizing the implementation of energy and water efficiency and conservation measures (ECMs), focusing on grid-interactive and net-zero emission buildings, and transforming a diverse set of DOE sites into net-zero emission testbeds. DOE recognizes that it may need to increase electricity use to replace site-delivered fossil fuels and will pursue on-site generation, efficiency, and electrification as pillars of an adaptation and decarbonization strategy. To optimize space for a flexible workforce, DOE will consolidate buildings where feasible and reconfigure space to support alternative workspace solutions. DOE will prioritize ECMs that upgrade legacy HVAC, lighting, and control systems, particularly for energy-intensive operations. DOE will work to expand initiatives such as the Smart Labs Accelerator[4], creating re-tuning training, and increasing the number of net-zero emission buildings (e.g., National Renewable Energy Laboratory's Research Support Facility) to accelerate progress toward the Administration's and DOE's goals.

One facility exemplifying energy reduction is LBNL's Integrative Genomics Building, a sustainable laboratory built to utilize 70 percent less energy than its predecessor facility. This building includes

[2] Scope 1 emissions are direct GHG emissions that occur from owned or controlled sources (e.g., on-site electricity generation, fugitive emissions, owned vehicles).
[3] Scope 2 emissions are indirect GHG emissions associated with purchased energy (e.g., purchased electricity, heat, or steam).
[4] The Smart Labs Accelerator is a FEMP and Better Buildings initiative that helps optimize energy, water, and waste use in laboratories.

passive design strategies such as electric heating systems with air and waterside heat recovery, which reduces the carbon footprint for heating by about half compared to a natural gas boiler system, while also enhancing resilience by lowering both the energy and water footprint, thereby reducing vulnerability to power outages and drought related water restrictions.

Deploy Clean Energy Sources and Modernized Infrastructure: DOE will accelerate its recapitalization programs to modernize its energy infrastructure and facilities to enhance resilience and reduce GHG emissions. The Office of Electricity (OE), which ensures the delivery of secure, resilient, and reliable energy across the nation, will continue to lead the effort to strengthen, transform, and improve energy infrastructure so consumers, including DOE, have access to resilient, secure, and clean sources of electricity. In addition, the Department's Grid Modernization Initiative, which coordinates electric grid-related research and development across the offices of OE, FECM, NE, Energy Efficiency and Renewable Energy (EERE) and Cybersecurity, Energy Security, and Emergency Response, will be updated within the year. The strategy includes an all-hazards approach to characterize and implement system resilience by considering infrastructure interdependencies, diversity in generation sources, and supply chains against emerging multifaceted threats (i.e., physical, cyber, extreme weather, pandemic, wildfire, geomagnetic disturbance, and earthquake). Outcomes include a full threat-to-consequence characterization of various resilience tradeoffs; a value-based approach to resilience decision-making that serves the U.S. government, private sector, and other stakeholders; and software tools that identify and quantify the costs and benefits of proposed resilience investments.

Within one year, the Program Offices, with support from SPD as needed, will finalize priority sites for large-scale distributed energy deployment and recapitalization plans. Furthermore, DOE will ramp up the installation of on-site clean distributed energy resources for both electric and thermal needs by:

- Installing on-site renewable energy sources, such as Lawrence Livermore National Laboratory's (LLNL) 3.3 megawatt (MW) Solar Center, as well as expanding deployment of systems that integrate renewable generation and storage that both lower GHG emissions and enhance resilience.
- Assessing, and where appropriate, reenergizing existing partnerships (e.g., DOE's Partnership for Energy Sector Climate Resilience) with utilities that are committed to addressing climate adaptation and mitigation opportunities as well as interested in collaborating with DOE to identify and deploy approaches to enhance climate resilience of DOE programs and site operations, as well as transition DOE sites to carbon pollution-free electricity use, with adaptation co-benefits (e.g., use of site-based distributed renewable energy technologies in combination with storage and microgrids to allow operations during central power outages).
- Partnering with utility providers to expand large-scale renewable and carbon-free energy systems using power purchase agreements and other procurement mechanisms. For example, the Northern California Electric Power Consortium and WAPA are creating a 50 MW solar power purchase contract, which will increase use of on-site clean pollution-free electricity, and provide off-grid electricity supply to enhance resilience to power outages.
- Assessing the potential to deploy small modular reactors (SMRs) and microreactors to decarbonize DOE's electricity supply, and power large energy consuming facilities. NE will develop and demonstrate technologies to improve the flexibility of these reactors. Distributed networks powered by SMRs or microreactors could provide reliable clean electricity to sites and

surrounding communities, while transitioning away from fossil fuel resources, and avoiding the intermittent nature of certain renewable energy technologies.

Improve Ecological and Land Use Management: E.O. 14008 requires that Federal agencies identify strategies that will encourage broad participation in the goal of conserving 30 percent of the Nation's lands and waters by 2030. DOE manages over two million acres of land, over half of which is comprised of vegetated or forested land. In these areas, DOE will continue to advance its ecological and land use management practices as a tool to enhance resilience (e.g., reduce wildfires) and to mitigate GHG emissions (e.g., provide additional carbon storage benefits). A significant portion of DOE land is either withdrawn Federal land or borders land held by Federal or state governments and natural resource-management agencies. DOE will coordinate with these stakeholders as well as tribes to promote effective management of ecosystems on contiguous lands, and to collaborate and share knowledge.

Implementation will prioritize the preservation and restoration of ecosphere appropriate forest cover, native grasses and forbs, and other indigenous plants to reduce fire risks to DOE sites and to encourage longer-term storage of carbon in biomass and soils, which also have the benefits of controlling destructive invasive species and providing wildfire protection. One example of improved ecological land management is ORNL's certified arboretum. The arboretum spans 26 acres of ORNL's west campus and contains 52 different species of trees native to Eastern Tennessee. These native trees have adapted to the landscape and require less water that non-native species, promoting resilience. Another example of beneficial land use management is LM and the University of Wyoming's 3-year Regenerative Grazing Study, which supports optimizing land use for grazing across LM sites and demonstrates that healthy land management practices, such as regenerative grazing, allow soils to capture more carbon as well as promote healthier vegetation and ecological systems. By optimizing grazing practices, LM is advancing long-term stewardship of the land and improving habitats for local species, helping promote site resilience.

The Office of Sustainable Environmental Stewardship will monitor and report progress on restoration and maintenance plans based on site provided Annual Site Environmental Reports and other sources as well as recognize high-performing DOE sites through the Sustainable Climate-Ready Sites Program. Within one year, Program Offices and sites will update site-level land management plans to include carbon storage considerations and initiate regular reporting on restoration and maintenance.

CHALLENGES & RISKS

The main challenges to implementing this priority action are funding prioritizations, energy-intensive mission growth and related operational processes, and Federal infrastructure development timelines. Significant and sustained capital investments will be required to upgrade building systems and infrastructure and deploy resilient energy and water technologies. Performance contracts will be leveraged where possible but are not always cost-effective due to low utility costs at most DOE sites. DOE has various energy-intensive loads that are driven by mission and operational requirements (e.g., supercomputers, particle accelerators, waste treatment facilities) and relies significantly on off-site electricity providers that employ a range of energy sources, including coal and natural gas. DOE will need to collaborate with these utilities to transition to carbon pollution-free energy sources. Finally, it can be difficult to forecast deployment timelines for large-scale infrastructure projects to increase on-site energy and water resilience and reduce GHG emissions due to uncertainties in the regulatory processes, funding cycles, and the need to integrate the energy and environmental justice concerns of neighboring communities, tribes, and other relevant stakeholders. The key to managing this action

includes effective and thoughtful planning approaches, streamlining processes where possible, and sharing lessons learned across DOE and with other agencies.

Climate change poses a risk to DOE with the potential to hinder the Department's mission and substantially increase the operational costs. For example, higher average temperatures in some regions have the potential to increase energy use for HVAC systems and strain transmission and distribution infrastructure. The implementation of effective climate strategies must not only increase the resilience of DOE sites to climate impacts but also reduce the Department's GHG emissions. New on-site distributed energy systems and ECMs that optimize energy use will enhance resilience against utility disruptions. New facility and infrastructure will be designed and sited to account for increased exposure to hazards, such as wildfires. Institutionalizing a clear and consistent approach to resilience planning will help ensure that DOE's programs are prepared to manage these risks.

PERFORMANCE TRACKING & COORDINATION

Performance metrics will be reviewed and updated to reflect evolving understanding of observed and anticipated climate impacts to enhance climate adaptation and mitigation co-benefits at DOE sites. Metrics will track progress in enhancing resilience as a co-benefit of reducing energy and water use, enhancing use of carbon pollution-free electricity, and improving land management. Program Offices will take the lead in planning, prioritizing, and implementing strategies at their respective sites to achieve the Department's goals. Performance will be tracked by the SPD using tools such as the Sustainability Dashboard. The Department will emphasize continuous learning by identifying common challenges and potential cost-effective approaches and sharing best practices and lessons learned. DOE is a national leader in energy technology, research, and policy, and will both leverage this expertise in its own operations and share best practices across DOE and with other agencies. DOE will also rely on lessons learned from its sites and other agencies to avoid duplication of effort and to accelerate deployment. For example, DOE will leverage space management and employee travel reduction strategies from the General Services Administration (GSA) as well as carbon storge and land management expertise from the Department of Agriculture and Department of Interior. DOE will consult with the Department of Defense (DoD) for lessons learned through DoD's Energy Resilience and Conservation Investment Program.

PRIORITY ACTION 3: Institutionalize Climate Adaptation and Resilience Across DOE Policies, Directives, and Processes

To ensure the Department operates in a consistent and efficient manner, DOE orders, directives, and policies must be updated to institutionalize climate adaptation and resilience actions across the complex while also addressing energy and environmental justice impacts. DOE commits to integrate climate information that reflects the current understanding of global climate change into its mission, programs, and management functions and decision points for managing its procurement, real property, public lands and waters, and financial programs including where appropriate, identifying opportunities to realign resources and needs for new resources. DOE will accomplish this through comprehensive operational planning, implementation of strategic projects, use of DOE procurement mechanisms to purchase products and services that are resilient and have a low carbon footprint, and ongoing monitoring of progress. DOE will map out entry points of climate information into management functions and responsibilities that effect funding or contracts. DOE will identify opportunities to incorporate climate criteria in grant and loan program solicitations. DOE will establish formal standards

and processes to ensure that policies and directives are implemented in a comprehensive and consistent way that integrates climate adaptation and resilience into Departmental guidance for standard operating procedures, including clear direction to DOE operating contractors.

DOE's facilities face an increasing risk of disruption to programs, operations and damage to real property due to a changing climate. Institutionalizing clear and consistent requirements for assessing and addressing these risks will help ensure that everyone at DOE understands the actions they need to take and are held accountable for implementing those actions. This will help with establishing and institutionalizing a common, Department-wide climate action approach to programs and operations, and allow for the sharing of tools, techniques, and success stories across the complex.

IMPLEMENTATION METHODS

DOE will institutionalize and integrate climate action into its culture by incorporating requirements and responsibilities into all appropriate orders, directives, policies, and processes.

Implement Building Standards and Codes: DOE's Office of Project Management Oversight and Assessment (PM) will develop a requirement that all new construction and major renovation projects meet or exceed the latest building standards and codes as set by ASHRAE 90.1, where appropriate. DOE will also review the new Federal building codes expected in summer of 2021, as well as other building energy standards and codes, such as the International Energy Conservation Code and International Building Code, to further promote climate action and determine the feasibility of making those codes mandatory for all new building construction at DOE. As an example, DOE is currently using the 2013 version of ASHRAE Standard 90.1, as required by Federal energy efficiency performance standards (10 CFR §433) and will consider accelerating the adoption of ASHRAE Standard 90.1 for new DOE buildings. By September 2021, PM will examine the feasibility of mandating the most recent ASHRAE standard for new construction, and if appropriate, will work through DOE's Directives Review Board (DRB) to institute any necessary changes by December 2021.

Develop Climate-Oriented Procurement Clauses: DOE's Office of Acquisition Management will lead the effort to review standard contract procurement clauses (e.g., "H" clauses) and identify opportunities to add or modify boiler plate contract language to establish clear climate action requirements (i.e., to be consistent with the Climate Adaptation Policy Statement). This includes requirements for contractors and suppliers to employ climate resilience and carbon footprint considerations, increased energy efficiency, use of carbon pollution-free electricity, and transition away from fossil fuel usage. The Office of Acquisition Management will work with other DOE offices to develop viable language for these "H" clauses, as necessary, by March 2022.

Integrate Climate Action Requirements into Established DOE Processes: SPD will partner with the Office of Sustainable Environmental Stewardship to integrate climate action requirements or standards into existing and applicable management systems and processes (e.g., DOE's 50001 Ready Program[5], ISO 14001[6], resilience and hazard assessment processes). In addition, DOE will integrate climate action

[5] The 50001 Ready Program is a free, self-guided approach based on the principles of the ISO 50001, an international standard for managing and improving energy use.

[6] ISO 14001 is a framework used to set up an effective environmental management system that ensures environmental impacts are being measured and improved. DOE requires the use of ISO 14001 certified or compliant processes at all of its operating facilities.

considerations into the Department's planning, programming, budgeting, and evaluation process and guidance.

Update DOE Directives and Technical Standards: By leveraging the Office of Sustainable Environmental Stewardship's Directives Resilience Gap Analysis report, the Office of Asset Management will lead the review of DOE directives and technical standards to identify areas to incorporate climate action requirements, including updates to contractor requirements. The Office of Sustainable Environmental Stewardship will provide support, as needed. They will then collaborate with each directive/technical standard's proponent office and DRB to establish proposed climate action language and develop timelines for updates. The directives to be reviewed will include, at a minimum, DOE Orders 150.1A (*Continuity Programs*), 413.3B (*Program and Project Management for the Acquisition of Capital Assets*), 430.1C (*Real Property Asset Management*), 436.1 (*Departmental Sustainability*), and 483.1B (*DOE Cooperative Research and Development Agreements*). The Office of Asset Management and Office of Sustainable Environmental Stewardship will work to identify additional DOE directives appropriate for incorporating climate action by September 2021 and will work with DRB to incorporate such updates by December 2022.

Define and Communicate Resilience Roles and Responsibilities: DOE will ensure that management has clearly defined and communicated organizational roles and responsibilities regarding who is responsible and accountable for assessing vulnerabilities of climate risks to site infrastructure and operations, as well as providing oversight and accountability for achieving resilience goals. DOE will pursue management practices that include: (1) Ensuring that management's roles, responsibilities, and accountability for resilience are clearly defined, communicated and understood; (2) Embedding resilience considerations into policies and risk management systems to guide day-to-day decision-making; and (3) Approaching management decisions with full consideration of the impacts of disruptions to operations and infrastructure from climate change risks. To further integrate climate action into management functions, DOE will require Program Offices and sites to assign senior level managers to ensure the execution and integration of the Climate Adaptation and Resilience Plan, and Climate Adaptation Policy Statement initiatives into programs and operations.

CHALLENGES & RISKS

Establishing an ambitious and reasonable schedule for incorporating climate action requirements into all appropriate directives/orders will require close coordination with the DRB, which manages this process and sets priorities and timelines determining when directives can be updated. Revising multiple updates may be a challenge as each directive will undergo a formal process involving extensive coordination and concurrence. Another challenge will be the potential for competition/conflicts between climate-related provisions and other requirements, and operational drivers, which DOE will need to address in contract deliverables and performance tracking.

While the primary action of modifying policies, directives, and processes will involve extensive coordination across many DOE organizations, this can be accomplished using established in-house personnel and resources. However, as climate action requirements are institutionalized, DOE will need to consider how to balance desired outcomes with available funding and personnel resources.

PERFORMANCE TRACKING & COORDINATION

Performance metrics will be reviewed and updated to reflect evolving understanding of observed and reasonably foreseeable climate impacts and the need to modify and institutionalize climate adaptation and resilience across DOE policies, directives, and processes, as well as ensure accountability through

DOE's leadership chain. DOE anticipates coordinating with other Federal agencies to exchange information on relevant climate-related policies, directives, and best practices to use for reference. DOE will define the work to be accomplished and create milestones to track progress on a quarterly basis.

PRIORITY ACTION 4: Provide Climate Adaptation Tools, Technical Support, and Climate Science Information

The Department will increase access to adaptation tools, technical support, and climate science for DOE sites and their surrounding communities, as well as other Federal agencies and tribal and local governments, to improve climate readiness and overall resilience posture. These strategies build upon existing efforts to disseminate available resources and develop and distribute additional tools, resources, and training. In addition, efforts to increase adaptation and resilience of surrounding communities enhances the resilience of DOE's operations by ensuring the safety and health of the workforce that lives in nearby communities, encouraging employees to consider resilience in their personal lives, developing emergency preparedness plans, as well as adopting other practices that can contribute to enhanced resilience.

IMPLEMENTATION METHODS

Building Codes for Resilience: DOE's Building Technologies Office (BTO) and the Federal Energy Management Program (FEMP) will provide technical assistance to DOE sites in the adoption of updated building codes that increase energy efficiency and resilience requirements. Specific areas of focus will vary by climate hazard risks drawn from DOE's vulnerability assessment tools. BTO and FEMP will coordinate with GSA and other Federal agencies to ensure a standardized definition and consistent approach are used across DOE sites regarding resilient building codes for Federal buildings. In addition, as directed by the Energy Conservation and Production Act (42 U.S.C. § 6834), FEMP will update Federal standards based on model code revisions to align with BTO's life-cycle cost-effectiveness methodology. FEMP will utilize model code updates to continually improve Federal energy efficiency standards, which is consistent with the Administration's goal to increase the energy efficiency of Federal buildings. More efficient buildings are less vulnerable to anticipated temperature fluctuations due to climate change.

BTO's Building Energy Codes Program (BECP) will assist DOE sites and surrounding communities with the adoption of the latest building codes and the implementation of code improvements. With support from the PNNL, BECP currently tracks state building energy codes adoption across the nation and is exploring opportunities to encourage building code adoption within cities and local jurisdictions, which could be used to assess progress.

High Performance Computing (HPC) Systems for Climate Simulations and Local Adaptation Planning: To address climate risks, DOE must ensure that sites have actionable and localized climate science data. Argonne National Laboratory (ANL) will adapt a high resolution dynamically downscaled climate model using its own HPC resources. The downscaled climate dataset covers the entire North American continent and has been used for studies on climate hazards and impacts. ANL will develop demonstration assessments for a few DOE facilities that can be used as a template for the rest of the DOE complex. ANL will also establish an online platform for sharing this data across DOE so that other sites can model climate vulnerabilities and impacts and identify local adaptation and resilience solutions.

DOE Climate Vulnerability Assessment Tools, Resources, and Training for Sites and Local Communities: FEMP will continue to provide support for its publicly available tools and resources, including the Technical Resilience Navigator (TRN). The TRN provides a systematic approach for sites to identify

energy and water resilience gaps, develop and prioritize solutions that reduce risks, and meet climate change adaptation and resilience goals. For example, PNNL utilized the TRN to identify risks to energy and water loads serving mission critical functions from vulnerability assessments and hazard assessments for its Richland campus. FEMP will provide pilot applications, cohort support, and workshops beginning in 2021 to help sites implement the TRN and identify and mitigate mission critical risks. This effort will leverage the localized climate data from ANL and FEMP and help ensure that DOE sites are aware of additional resources, such as REopt Lite[7] and 50001 Ready Program. The progress of DOE's TRN cohort will be evaluated based on the identified risks and solutions to address any resilience gaps for each site. Once measures to address these gaps have been implemented, the improvement in site resilience posture can be evaluated.

DOE's OE provides tools (e.g., Dynamic Contingency Analysis Tool[8]) and training related to grid infrastructure resiliency. OE will work with DOE sites and local communities to advance climate threat-based risk assessment and prioritization methods for grid planning processes, improve asset management practices, and pilot or validate these approaches at a DOE site. Additionally, mechanisms to incorporate climate risk assessment into the utility planning process are currently being analyzed by DOE and other parties. OE will partner with the PMAs, which operate and transmit energy of Federal hydroelectric dams, and DOE sites to establish a standardized process to assess the risk of drought and other extreme weather events to Federal operations and grid infrastructure which will take two or more years to develop and institutionalize.

The Office of Asset Management and Office of Sustainable Environmental Stewardship will lead the development of virtual and in person training for sustainable acquisition, fleet electrification, environmental management systems, climate change threats and solutions, and other sustainability topics in FY 2022. They will also work with DOE sites to ensure they are aware of the tools and resources available to assist with resilience planning.

Provide Adaptation and Resilience Support for Energy and Environmental Justice Communities Near DOE Sites: For far too long, communities of color and low-income communities have borne the brunt of pollution to the air, water, and soil they rely on to live and raise their families. The clean energy revolution must lift up these communities that have been left behind, and make sure those who have suffered the most are the first to benefit. By providing climate adaptation and resilience support for energy and environmental justice communities near DOE sites, the Department will advance priorities related to climate resilience, equity, and energy and environmental justice. In addition to ongoing efforts by EM and LM, the Office of Economic Impact and Diversity (ED) will collaborate with local leadership and stakeholders, and provide technical assistance and training deemed most critical by the energy and environmental justice community. DOE will develop a process for sharing relevant tools and resources that ED will use to facilitate impactful discussions with energy and environmental justice community stakeholders.

The progress of efforts to support energy and environmental justice communities in advancing climate adaptation and mitigation measures will be analyzed through feedback from community leaders and stakeholders. In addition, DOE will utilize metrics such as the number of projects completed and

[7] REopt Lite is a tool to assist with identifying the optimal mix of renewable energy, conventional generation, and energy storage technologies for buildings campuses and microgrids.
[8] The Dynamic Contingency Analysis Tool assists with assessing the impact and likelihood of extreme contingencies and potential cascading events across power systems and interconnections.

stakeholders impacted and analyze the enhanced resilience posture to demonstrate the efficacy of efforts. Analyses of health and economic benefits will also be performed to enable a broader understanding of the project's impact.

CHALLENGES & RISKS

The challenges related to the implementation of tools and training include the identification and engagement of appropriate stakeholders, development of an outreach plan to help sites take the time during these processes to foster trust with local communities, and the availability and time commitment of participants. Additionally, climate data training is needed to inform decision-making on climate impacts and adaptation.

Mission disruptions may occur due to climate hazards and could result in disruptions to infrastructure and information, such as specialized scientific facilities, data holdings, HPC/data centers, LM sites, national laboratories, and energy/water systems. By providing climate adaptation tools, technical support, and climate science information on adaptation and resilience, DOE sites and surrounding communities can better understand, manage, and mitigate climate risks.

Within available resources, DOE will update and share climate adaptation and resilience methods and tools, with DOE sites, local communities, tribal and local governments. For example, the initial TRN cohort of DOE sites is planned as part of the existing budget; however, implementation of the TRN across the DOE complex will require additional resources or strategic prioritization of available resources. Furthermore, DOE will evaluate resource needs to develop an online platform to deliver the localized climate dataset to the respective DOE site assessment teams, to analyze models and to develop demonstration assessment studies.

PERFORMANCE TRACKING & COORDINATION

To advance this priority action, DOE will create metrics to track performance on a quarterly basis. Metrics will allow tracking of progress in developing and providing climate adaptation tools, as well as providing technical support and climate science information for adaptation and mitigation. DOE will coordinate with tribal, state, and local governments, as well as with other Federal agencies, such as the National Aeronautics and Space Administration and NOAA for climate and extreme weather information, to provide communities near DOE sites with the information and resources necessary to implement climate adaptation and mitigation measures. DOE will explore the use of various Federal mechanisms for sharing information, such as the Federal Climate Resilience Toolkit, as potential vehicles to increase access to DOE climate adaptation tools, technical support, and climate science information.

PRIORITY ACTION 5: Advance Deployment of Emerging Climate Resilient Technologies

DOE will increase climate adaptation and resilience across its sites by demonstrating and deploying cost-effective climate resilient and carbon pollution-free energy technologies. In addition, DOE will assess practices to enhance the purchase of low carbon footprint products and services. The Department is currently advancing research and development programs for climate technologies at its national laboratories and identifying opportunities to use its sites to demonstrate the effectiveness of these innovative technologies and practices. DOE could increase climate performance at its sites by leveraging research, development, and demonstration programs being pursued at the Department. In addition, using DOE sites as testbeds can accelerate the deployment of these technologies and practices throughout the Federal government and private sector.

DOE will partner with stakeholders such as local and state governments, universities, and community organizations to ensure these technologies are made available nationwide, including for disadvantaged communities and populations. The dissemination of technologies beyond the DOE complex will help increase accountability through more robust climate change adaptation and mitigation actions and efforts to elevate, support, and increase access for disadvantaged communities and populations, such as black, indigenous, and people of color (BIPOC). By scaling up the development and deployment of the resilient and clean energy technologies of the future, DOE will help put Americans in construction, skilled trades, and engineering to work—building a new clean energy infrastructure and economy, while making sure that every American worker and community can benefit from and see their future in reliable, resilient, clean energy solutions.

IMPLEMENTATION METHODS

Develop, Demonstrate, and Deploy Innovative Climate Technologies: DOE will use its sites as testbeds to pilot innovative climate adaptation and mitigation technologies that improve both grid and climate change resilience as well as reduce GHG emissions. These demonstration projects will involve the advancement of climate technologies with site-specific energy/water resilience components such as new microgrids, power delivery systems, microreactors, water reuse systems, and gray water systems for landscaping. For instance, EERE will use the National Renewable Energy Laboratory (NREL) as a testbed for electric vehicles with a goal of electrifying 100 percent of NREL's fleet within two years—contributing to both reductions in transportation fossil fuel use, as well as enhanced site resilience by leveraging electric vehicle battery storage as a backup power source. NREL will draft a report, using the information gathered from this pilot, to help other DOE sites and Federal agencies prepare for fleet electrification by understanding potential issues. The Waste Isolation Pilot Plant (WIPP) is working to convert all underground vehicles to be electric. This will provide a showcase for electric vehicle conversion for industrial vehicles, while simultaneously increasing underground air quality, worker safety, and operational efficiency, as well as potentially increasing resilience by leveraging the battery storage capacity for backup generation. WIPP will also investigate the possibility of electric long-haul trucks for its waste transportation fleet. Another example is that DOE's Energy Assurance for Critical Infrastructure program and SNL are looking to deploy a microgrid in collaboration with Kirtland Air Force Base.

DOE will pursue the resilient net-zero challenge with demonstration projects at sites with a variety of missions, geographical diversity, and different energy sources. The goal of this approach will be to develop and demonstrate innovative, regionally dependent carbon-neutral and climate resilient solutions at varying scales and operating conditions that result in adaptation and mitigation benefits. The demonstration projects will develop a common framework for addressing the net-zero challenge, leverage lessons learned and best practices, and expand opportunities for technology and information transfer across the DOE complex and private sector to advance zero-emission deployment in the marketplace. Transitioning to zero emissions, using technologies such as on-site distributed renewable energy generation as well as the use of more energy efficient equipment will not only reduce energy consumption and emissions, but also reduce impacts from climate change on energy demand and supply. NE is advancing technologies to improve the flexibility of nuclear plants, including SMRs and microreactors, and provide energy resources that contribute to enhanced adaptation and mitigation. Additionally, NETL will assess opportunities for climate technologies that could be deployed at their campuses and could hold on-site demonstrations for technology transfer. Furthermore, working with the responsible Program Offices, ED will assess the feasibility of using DOE sites as resilient hubs for

disadvantaged communities, in partnership with relevant stakeholders, including community organizations, minority serving institutions, and governmental authorities. For instance, these hubs will provide a safe space for DOE employees and the surrounding community when faced with severe climate threats. Once completed, successful solutions from these demonstration projects will be deployed at other DOE sites. DOE Program Offices managing site locations will track progress toward their respective technology demonstration and deployment projects.

Increase Awareness of Cost-effective Resilient Technologies: To promote energy and environmental justice, DOE will increase awareness at its sites and neighboring environmental justice communities on carbon neutral and cost-effective resilient technologies as well as affordable clean energy solutions. For example, LANL is already working with DOE science and energy programs to create economic opportunities for surrounding communities. Additionally, DOE will create an entrepreneurial pipeline to accelerate the development of emerging climate change technologies within energy and environmental justice communities by providing educational opportunities such as internships. ED will identify communication strategies and assess existing opportunities for resources and internships for neighboring energy and environmental justice communities and BIPOC by September 2022.

CHALLENGES & RISKS

Technology demonstration and deployment can take years to successfully mature. Additionally, demonstration and deployment projects can be resource and budget intensive. Throughout the demonstration process, various DOE programs and offices must coordinate to address challenges. Challenges to establishing an entrepreneurial pipeline for neighboring energy and environmental justice communities and BIPOC include engaging with a large set of communities, defining, and identifying who fits in this space.

Demonstrating innovative climate technologies and conducting educational activities will be a lengthy process. Additionally, developing demonstration projects will require resources including facilities, time, and availability of employees. For certain demonstration projects, new facilities and modifications to existing facilities will be necessary.

PERFORMANCE TRACKING

To track the progress of deployment and demonstration projects, DOE will measure the number of tests or demonstrations initiated, technological advancements in climate readiness, impact of stakeholder outreach, and improvements in the resilience of DOE sites to anticipate climate change impacts as a result of innovative facility and infrastructure projects. For example, over the next five to seven years, NE will build several nuclear demonstration projects and nuclear test beds. As DOE works to develop the entrepreneurial pipeline, DOE will assess metrics such as the number of people gaining access/assistance, number of educational opportunities, number of connecting events (e.g., ARPA-E Energy Innovation Summit), dollars provided to support development of climate change technologies, and number of weighted opportunities to support BIPOC technology development.

IV. Specific Topic Areas

SPECIFIC TOPIC 1: Update Climate Vulnerability Assessments

Climate change can result in cascading events, disrupting supply chain transportation routes, causing energy and water system shutdowns, resulting in less-suitable conditions, and so much more. These potential impacts put DOE's mission and physical assets at risk. DOE has identified its top five vulnerabilities to be the following: (1) workforce, (2) supply chain and distribution, (3) energy and water systems, (4) mission specific operations and equipment, and (5) real property and physical assets. Multiple factors were considered in identifying these vulnerabilities, including the types of climate change hazards and the associated vulnerabilities to critical DOE infrastructure and operations, scaling considerations associated with DOE-wide hazards and vulnerabilities, and likelihood or severity of damage of disruption given a climate event. To address these vulnerabilities, DOE will implement a Department-wide approach to ensure that the overall mission is not impacted and SPD will work with the Program Offices to identify major vulnerabilities. Conducting vulnerability assessments and the development of resilience plans will ensure that site-level vulnerabilities are identified and addressed. These activities will be completed within one year of the issuance of this Climate Adaptation and Resilience Plan.

DOE'S TOP FIVE VULNERABILITIES

Workforce: Regardless of region, DOE's workforce must adapt to rising temperatures, extreme weather events, and a rising number of epidemics and pandemics. These climate hazards can affect employee health and result in workforce inefficiencies, site evacuations, and inability to perform daily operations. If left unaddressed, DOE may experience a decline in productivity or an inability to perform mission critical tasks. DOE's outdoor workforce is particularly vulnerable to the climate hazards identified above. Within vulnerability assessments, sites with an outdoor workforce will identify policies and actions to increase employee health and safety, and limit workers' exposure to extreme conditions. The Office of Environment, Health, Safety and Security will assist with integrating climate-related risks into existing health and safety protocols and processes.

To address these types of challenges and modifications to worker health and safety conditions, DOE will coordinate with workers and site unions. Additionally, Program Offices and sites will procure equipment to increase workforce health and safety, reducing the effects of outdoor exposure, as needed. At DOE's Hanford Site, ice vests are utilized to increase employee comfort and reduce heat stress. Barriers to these proposed adaptation strategies include prioritization of equipment procurement or work schedule changes, workforce opposition to shifting schedules, and potentially impractical operation schedules for the work and logistics performed at the site.

Supply Chain and Distribution: Extreme weather events (e.g., hurricanes and extreme storm events) or events associated with a warming climate (e.g., wildfires and sea level rise) can impact transportation and manufacturing infrastructure and result in supply chain disruptions of mission critical supplies. Failure to address these climate hazards can result in work disruptions and inhibit mission critical operations. To reduce the risks of climate hazards on supply chains, sites will identify vulnerabilities related to transportation and distribution disruptions within their vulnerability assessments. These vulnerability assessments will also identify alternative procurement opportunities to diversify supply chain sources and alternative distribution routes for site access. Once these risks are identified, Program Offices will work with sites to assist with the resilience implementation process, as needed.

These strategies will both reduce site operational risks from climate change and help sites adapt to climate hazards. Barriers to implementing these actions include prioritization and challenges with identifying and implementing alternative contracts.

Energy and Water Systems: DOE has seen the impacts of extreme weather, wildfires, and flooding on the Department's energy infrastructure and supply chain. These events have resulted in downed power lines, failed transformers, and disrupted power distribution. Rising temperatures and extreme weather conditions also threaten the availability of water or can lead to an overabundance of water. For example, drought affects the water supply and the production of hydropower at DOE's PMAs, which operationally exposes them to the risk of significant market price shocks in purchasing additional power when they cannot independently meet full contractual power delivery requirements to customers during extreme weather events. In contrast, storm-related flooding impacts operations at the SPR. Heat and drought-related electricity spikes further exacerbate the energy and water feedback loop. The interdependence of energy and water must be considered when addressing DOE's climate change readiness.

DOE sites are taking steps to increase energy system resilience. At INL, wildfires were identified as a threat to power supply, and subsequently, 3,000 transmission and distribution poles were painted with fire-retardant to protect against brush fires. When the 100,000-acre Sheep Fire hit in 2019, INL's treated assets remained intact and power kept flowing. A regional utility on the INL property did not implement this same tactic and lost many poles and lines, suffered impacted power delivery, and faced significant repair costs. LANL is planning a 6-8 MW photovoltaic electric generating station to increase its energy resilience. To increase water resilience, DOE sites will prioritize water reuse and conservation, particularly in the western region of the United States where potable water resources are in high demand. The Nevada National Security Site is considering a remote groundwater sensing demonstration project to detect the presence and levels of groundwater in the desert. This effort would pilot remote monitoring and pave the way for transition to comprehensive remote monitoring on the heavily secured and remote site.

Mission Specific Operations and Equipment: DOE's mission utilizes specialized facilities that require significant water and energy resources. As a result, mission specific equipment such as particle accelerators, bio-refinery pilot plants, supercomputers, and waste processing facilities face disruptions due to drought or extreme weather. DOE's nuclear security mission is critical to national security and is also largely conducted at DOE sites that are vulnerable to extreme weather conditions and climate events. DOE's environmental mission could also experience disruptions if facilities dedicated to radioactive waste processing and disposal are impacted by climate hazards or if groundwater remediation systems are impacted by droughts. Failure to react to climate threats could result in the interruption of processes and lead to a significant loss of time and research.

All DOE sites are required by DOE Order 150.1A to maintain plans that identify mission essential assets and mission essential functions. Sites will also be asked to identify mission critical operations and equipment in vulnerability assessments, which are to be updated every four years. Once climate impacts on mission specific operations and equipment have been identified, Program Offices will work with sites to ensure that applicable cost-effective strategies are implemented. Unfortunately, some identified risks may have a low adaptive capacity or backup of critical systems, and the cost of identifying and implementing an alternative process is high. In addition, when seeking to establish new/expanded programs and projects, climate threats such as reduced water supplies due to climate

change and droughts should be taken into consideration. Proposed projects with a significant water need in drought-prone regions may be less feasible going forward.

Real Property and Physical Assets: Prolonged droughts coupled with warmer weather have resulted in increased wildfires, affecting DOE property in the western region of the United States. Increased precipitation and severe storms have also impacted DOE sites. As these climate threats become more prevalent, DOE's property and physical assets may face damages that could impede site operations. Since all DOE sites may be impacted by climate change, sites must identify climate hazards that impact facilities within their climate vulnerability assessments as well as develop resilience plans to address the vulnerabilities and increase the resilience of existing facilities. Examples of cost-effective hardening strategies as resilience solutions include the installation of berms or bioswales to protect against storm surge, elevating equipment such as substation systems to avoid flooding, undergrounding of power lines, usage of vegetation management, and usage of fire-retardant paint. When highly vulnerable properties are identified without identified cost-effective actions to reduce risks, sites will collaborate with their Program Office to determine feasible resilience solutions.

SPECIFIC TOPIC 2: Enhance Climate Literacy in DOE's Management Workforce

DOE recognizes that a climate-ready organization requires a workforce that can safely and successfully adapt to climate change related challenges, identify, and take advantage of new opportunities, and foster a culture of innovation. A resilient workforce requires knowledge of climate impacts on-site operations, DOE communities, and worker health and safety. Employees should be aware of climate vulnerabilities as well as tools, technology, and guidance available to address those risks. To ensure climate literacy, all DOE employees will be required to take training on climate adaptation and mitigation. This training will help employees develop the skills and climate knowledge necessary to manage and protect the Department's physical assets and its workforce in a changing climate.

IMPLEMENTATION METHODS

Climate Change Training and Resource Hub: DOE plans to improve the climate literacy of its workforce by creating a hub for climate change resources, which will include tools, technical resources, climate science information, and on-demand climate awareness training. DOE will develop a required high-level general introductory course on climate change for all employees (i.e., current and new employees). The course will address the latest climate trends associated with issues such as sea level rise, extreme temperatures, precipitation, flooding, and drought, the variation of climate threats on a temporal and spatial basis, and the potential impact climate trends will have on DOE's mission and operations. This mandatory training will also discuss potential adaptation and mitigation strategies to address these climate threats. DOE will capitalize on existing training and resources when compiling and developing training. To further improve climate literacy within the Department, DOE will identify appropriate DOE job classifications that require additional tailored annual climate trainings. Existing training will be utilized as appropriate and will be updated with new information and case studies each year. The Office of the Chief Human Capital Officer will also explore the recruitment of climate expertise with programs and examine the potential use of direct hire authority for these disciplines.

DOE's Office of the Chief Human Capital Officer will partner with FEMP to take the lead in tracking progress toward these actions. These offices will work to identify specific DOE organizations for the implementation of each action, and SPD and the Office of Sustainable Environmental Stewardship will

assist as needed. The Department will begin this effort immediately and will identify metrics to identify progress in deployment of training and enhance climate literacy.

CHALLENGES & RISKS

Developing, updating, and maintaining training requires time, staffing, and funding. Fortunately, DOE can utilize several existing webinars and resources to build a more comprehensive training that is applicable to DOE field sites and Headquarters. In terms of risks, new climate technologies, climate science information, and evolving policies means that the training and resources must be updated regularly. Frequent communication of new climate-related information and findings will also provide employees with important information to assist with their daily activities. The preparation of training materials and creation of a hub that is easily accessible will involve extensive coordination across many DOE organizations but can be accomplished using established in-house personnel and resources.

PERFORMANCE TRACKING & COORDINATION

To objectively assess progress, DOE will not only track the number of DOE employees required to receiving climate training and those who receive the training, but also the effectiveness of this training. DOE will coordinate with other government organizations, such as the Environmental Protection Agency, NOAA, DoD, GSA, the United States Global Change Research Program, and others to implement this effort.

SPECIFIC TOPIC 3a: Enhance Climate Resilience for Climate-Ready Sites and Facilities

DOE plans to integrate climate readiness into its facilities and infrastructure asset management program and has identified the Department's approach to incorporate climate change adaptation and mitigation efforts into its management of real property (i.e., reduce facility related energy and water usage, employ resilience enhancing land use planning and management principles, and use sustainable and resilient remediation options). These efforts not only improve sites' climate readiness by reducing reliance on energy and water resources, but also reduce the effects of climate change by conserving resources and reducing GHG emissions. The Department's approach focuses on two main areas of facility management, which are (1) design and construction and (2) operations and maintenance.

IMPLEMENTATION METHODS

Design and Construction: This aspect of facility management focuses on planning and involves the integration of climate-ready measures into the early stages of building design. DOE has a well-established decision-making process for developing facility construction projects from concept to completion. This process is included in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*; the order defines Critical Decision phases/milestones for large-scale construction projects from preliminary and conceptual design options through acceptance of the constructed facility. Each of these milestones contain requirements for incorporating the Guiding Principles for Sustainable Federal Buildings (Guiding Principles) into the design, or in the case of acceptance of the constructed facility, documenting how the facility meets sustainable design goals. Currently, under the Guiding Principles, projects must assess localized risks and incorporate design features to enhance the resilience of the building design and operations. In addition, DOE Order 413.3B requires that, "At a minimum, all new construction and major building renovations must meet U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Gold certification absent an approved waiver."

DOE will direct sites to update their vulnerability assessments and develop resilience plans within one year of issuance of the Climate Adaptation and Resilience Plan. DOE will develop guidance to assist sites with developing location specific design criteria for new facilities and non-occupied building infrastructure projects (i.e., utilities and other supporting infrastructure). This will ensure that climate vulnerabilities and climate-ready solutions are incorporated into these projects.

DOE plans to review Order 413.3B and determine the feasibility of setting design criteria that address climate action as a baseline requirement for all new construction projects covered by the Order. Under such a policy, building features and design elements intended to address climate change through adaptation and resilience would be standard requirements rather than building enhancements from a financial perspective. After reviewing Order 413.3B, DOE will pursue these changes while complying with applicable legal and regulatory requirements that may prohibit the Department from establishing climate-related design elements as baseline requirements.

Operations and Maintenance (O&M): This aspect of facility operations involves activities required to keep the facility in working order and able to perform its mission. Facility managers must routinely repair broken equipment, renovate aging systems, and perform preventive maintenance to prolong the life of building equipment. O&M activities consume significant energy and water resources and require continual attention to keep consumption to a minimum.

DOE conducts comprehensive energy and water evaluations at each of its covered facilities every four years. The evaluations identify operations that regularly consume energy and water resources, identify opportunities to eliminate or reduce consumption, and analyze the cost-effectiveness of implementing those opportunities. After evaluations are complete, sites should consider the life-cycle cost-effective opportunities as stand-alone projects or bundle multiple conservation measures into directly funded projects or alternatively financed projects, such as Energy Savings Performance Contracts (ESPCs) and Utility Energy Service Contracts (UESCs).

Conducting high-quality energy and water evaluations is dependent on obtaining reliable energy and water consumption data for each facility and requires accurate building-level metering. Metering data will also help sites measure and verify the effectiveness of the conservation measures they have implemented. FEMP is currently updating guidance to help Federal facilities improve their energy metering and include water metering. The Office of Asset Management will develop a Department-wide metering plan to reflect this guidance and expand its own metering efforts by the summer 2022.

In addition, the Department will update DOE Order 430.1C, *Real Property Asset Management*, to include a requirement for sites to consider the results of their energy and water evaluations when conducting their asset functionality assessments and incorporate life-cycle cost-effective ECMs into facility modernization efforts. This will add depth to the current DOE requirement that each site must conduct a functionality assessment every five years to identify modernization needs.

Finally, DOE will direct sites to review environmental aspects and emergency operation scenarios of O&M activities to determine if changes are needed to address climate vulnerabilities. This includes evaluations to confirm long-term environmental remediation activities and long-term legacy site maintenance activities will be adequate given any projected vulnerabilities. Sites using the TRN will complete a vulnerability assessment as part of the process and will identify O&M activities that need adjusting to address identified climate risks.

CHALLENGES & RISKS

While DOE expects that its sites will successfully conduct energy and water assessments to identify opportunities for increasing climate resilience, the Department also believes sites will encounter challenges in prioritizing the necessary resources to implement those opportunities relative to other Departmental funding priorities. Pursuing performance contracting (e.g., ESPCs) is an avenue many sites can use to reduce large, up-front implementation costs. However, since many sites have already implemented low-cost, high payback opportunities, it will remain a challenge to bundle projects in a way that allows such performance contracts to properly demonstrate cost savings.

PERFORMANCE TRACKING & COORDINATION

The Department will track site-level data relating to when each DOE site has conducted a climate vulnerability assessment and developed a resilience plan. In addition, DOE will track facility-level data relating to when sites have conducted energy evaluations, water evaluations, and functionality analyses. DOE will use the Sustainable Climate-Ready Sites initiative to recognize leaders and encourage progress, through sharing lessons learned and best practices in sustainable and resilient facility and land management.

SPECIFIC TOPIC 3b: Ensure a Climate-Ready Supply of Products and Services

The Department depends upon a strong, resilient, sustainable, and secure supply chain to ensure our mission and operations are successful. The availability of critical manufacturing capacity, raw materials, and essential goods and services can be threatened by extreme weather events, biological impacts (e.g., pandemics), and other climate-related conditions. DOE will ensure a climate-ready supply of products and services by conducting a supply chain analysis for critical items while also exploring options to require products that are sustainable, from underrepresented businesses, and Made in America, as appropriate. This will improve mission execution across the Department while addressing energy and environmental justice concerns and reducing carbon impacts. DOE will also explore approaches to use its procurement authority to purchase products and services with a low carbon footprint. This effort will build upon the requirement in E.O. 14017, *America's Supply Chains*, which requires the Secretary of Energy to submit a report within 100 days of issuance of the E.O. that identifies supply chain risks for high-capacity batteries (e.g., electric vehicle batteries) and provides policy recommendations to address these risks. The E.O. also requires agencies to identify key supply chain risks relating to semiconductors, batteries, and strategic minerals, which are all critical to the energy sector.

DOE will explore approaches to develop a more resilient, sustainable, secure, and diverse supply chain, such as implementing approaches to encompass greater domestic production as well as identifying and diversifying supply chain sources, while simultaneously supporting small businesses, and encouraging economic growth in neighboring environmental justice communities.

IMPLEMENTATION METHODS

DOE plans to integrate the evaluation of climate-related acquisition and procurement efforts into its daily operations and culture as well as request that each site conduct an analysis of their supply chain risks and vulnerabilities.

Climate-Ready Purchasing Preference: When evaluating purchases, DOE will give preference for various types of vendors, products, and services to ensure DOE is climate-ready. DOE will give preference for the Buy American Act and consider U.S. based vendors to the maximum extent practicable. DOE will

also give preference for small business concerns, especially disadvantaged, women owned, and historically underutilized businesses (HUBZones). Additionally, DOE will give preference for sustainable products or locally sourced products (e.g., including an energy and environmental justice consideration), as well as products with a reduced carbon footprint. To carry out these climate-ready purchasing preferences, DOE will leverage its existing acquisition and financial assistance authorities and will evaluate what changes are needed for appropriately including climate considerations in the procurement decision process.

Supply Chain Analysis: Each DOE site will conduct a supply chain analysis to determine the reliability and vulnerability of their critical supply chains, and the carbon footprint of its suppliers. This analysis will be incorporated into their vulnerability assessment process and the results will be used to identify critical items that are most at risk to ensure the Department can continue its mission. Options will be identified to address both site specific and Department-wide risks. This risk analysis will consider factors such as gaps in domestic manufacturing capabilities, supply chains with limited suppliers, physical location of key suppliers with climate vulnerabilities, resilience actions taken by suppliers, and availability of alternative sources.

DOE's Office of Acquisition Management will take the overall lead in tracking the Department's progress toward these actions and will work to identify specific offices to serve as the primary lead for implementation. DOE will begin this effort immediately and will establish timelines to review quarterly progress for each priority action based on percentage of activity completed by the targeted timeline.

CHALLENGES & RISKS

The Federal Acquisition Regulations (FAR) and the Department of Energy Acquisition Regulations (DEAR) may need to be updated to create specific preferences. Across the DOE complex, the sites perform a variety of missions and are likely to identify a multitude of critical items that may require different risk adaptation approaches. It may be a challenge to determine a select few critical products and services when the breadth of DOE's mission is considered. It also may be a challenge to characterize the carbon footprint of its suppliers. In terms of risks, updating the FAR and DEAR along with educating Contracting Officers will take time. While DOE plans to accomplish these actions using established in-house personnel and resources, there may be limited options available to address certain critical materials.

PERFORMANCE TRACKING & COORDINATION

DOE will establish quantitative measures to objectively track progress. Based on site input, the Department will identify and track agency-wide progress on critical items, services, and adaptation strategies. DOE will coordinate with other government agencies, such as GSA and others to implement this effort as well as share best practices.

V. Conclusion

The Climate Adaptation and Resilience Plan provides a pathway for the Department to adapt to current and projected impacts of climate change while also leveraging the co-benefits of reducing energy demand and GHG emissions. The actions described in this plan will assist the Department in better understanding current and future climate risks that may impact DOE's mission and operations. These actions will also help to characterize DOE's climate vulnerabilities as well as develop the climate science and resilience tools needed to adapt and respond to climate hazards. By assessing vulnerabilities, providing adaptation tools, prioritizing funding, and institutionalizing climate requirements and literacy throughout the workforce, DOE will be able to develop and deploy climate resilient technologies, tools, and practices throughout the DOE complex and within surrounding communities.

Successful implementation of this plan will require collaboration and coordination across DOE, with other Federal agencies, and with non-Federal stakeholders. The priority actions and activities discussed within the specific topic areas of this plan will be incorporated into DOE's planning, operations, and budget development processes. The incorporation into DOE's planning processes includes integration within other departmental plans, such as DOE's Sustainability Plan and laboratory planning documents, to ensure consistency of planned resilience and climate goals as well as tracking year over year progress. Furthermore, the Department will collaborate with other Federal agencies as appropriate through the National Climate Task Force and interagency working groups, as well as investigate new opportunities for collaboration as appropriate. DOE will continue to leverage its unique modeling, climate science expertise, and engineering capabilities in collaboration with other agencies and institutions to continuously improve its understanding of climate change impacts and identify appropriate adaptation and mitigation strategies. Substantial progress can be achieved with the formation of strong partnerships to increase resilience of DOE and create more resilient communities.

This plan and the Climate Adaptation Policy Statement provide guidance for DOE to incorporate climate change adaptation and mitigation into daily business operations at Headquarters and each DOE site. DOE will review and revise the Climate Adaptation and Resilience Plan to acknowledge successes and lessons learned as well as continue to set ambitious goals. By creating a more climate resilient Department, DOE can then build a more climate-ready energy system that ensures clean, affordable, and reliable energy, and promotes energy and environmental justice and well-paying jobs. Thereby, increasing the nation's energy security and helping to create a sustainable clean energy economy.