

MEETING THE CLIMATE CHALLENGE



Department of Defense Budget

Fiscal Year (FY) 2023

Office of the Under Secretary of Defense (Comptroller)

April 2022

The estimated cost of this report or study for the Department of Defense is approximately \$24,000 for the 2022 Fiscal Year. This includes \$280 in expenses and \$24,000 in DoD labor.

Generated on 2022Apr11 RefID: A-45A00FD

MEETING THE CLIMATE CHALLENGE

MEETING THE CLIMATE CHALLENGE

Table of Contents

OVERVIEW 2

 TABLE 1. Climate Funding by Component 2

 TABLE 2. Funding by Climate Line of Effort..... 3

 TABLE 3. Climate Category Fund Types..... 3

CLIMATE LINES OF EFFORT 4

I. INSTALLATION RESILIENCY AND ADAPTATION..... 4

II. OPERATIONAL ENERGY AND BUYING POWER..... 19

III. SCIENCE AND TECHNOLOGY 22

IV. CONTINGENCY PREPAREDNESS..... 38

CLIMATE BUDGET BACKUP EXHIBITS..... 41

 TABLE 4. Climate Funding by Appropriation 41

 TABLE 5. Climate Funding by Line of Effort and Category 42

MEETING THE CLIMATE CHALLENGE

OVERVIEW

Climate change is reshaping geostrategic, operational, and tactical environments with significant implications for U.S. national security and defense. Increasing temperatures, changing precipitation patterns, and more frequent, intense, and unpredictable weather conditions are impacting military readiness and imposing significant costs on the Department while exacerbating risk and creating new challenges to U.S. interests around the world. To train, fight, and win in this increasingly complex environment, the Department must consider the effects of climate change at every level of the enterprise and invest accordingly. The FY 2023 President’s budget request prioritizes Departmental investments that enhance operational capability, mission resilience, and readiness.

Through increasing platform efficiencies to mitigate logistics risk in contested environments, hardening critical infrastructure against climate impacts, and deploying new technologies that strengthen capability, the Department is committed to solutions that are mission essential and provide climate benefits. The budget request reflects that commitment and includes \$3.1 billion of investments that will bolster U.S. security in the near-term and lay the groundwork for a more capable future force. Each Service and many Defense Agencies play an important role to achieve these goals, as shown in Table 1.

TABLE 1. Climate Funding by Component

	FY 2023 \$ in thousands
Department of Army	725,648
Department of Navy	718,830
Department of Air Force	389,502
Office of Secretary Defense /Defense-Wide	1,221,575
Total	3,055,555

The Department’s Climate investment is intended to ensure the Department can meet all mission requirements and maintain the ability to operate under changing climate conditions. The investments will improve installation energy and physical resilience, increase operational energy efficiency and resiliency, develop new capabilities to keep the U.S. military at the cutting edge, and reduce future operational costs. Investments also seek to modernize Department operations to keep pace with industry, including the auto sector’s rapid shift to electric transportation.

The Department’s efforts to address the national security challenge presented by Climate change are reflected in a \$3.1 billion subset of the FY 2023 budget request. While each Service funds specific missions within their respective topline, the Department’s efforts are coordinated across the enterprise. Climate investments are organized into four lines of effort and identified funding is shown in Table 2:

MEETING THE CLIMATE CHALLENGE

- *Installation Resiliency and Adaptation* – to adapt military facilities to withstand increasingly challenging conditions and strengthen their ability to rapidly recover from disruptions to public infrastructure.
- *Operational Energy and Buying Power* – to improve the energy efficiency of existing operational platforms and propulsion systems to enhance capability and reduce logistics supply requirements for deployed forces.
- *Science and Technology* – for basic and applied research focused on technology prototyping, energy demand reduction and management, advanced energy supply, and energy storage to keep the U.S. military at the cutting edge.
- *Contingency Preparedness* – for wargames, exercises, and other planning tools to ensure the Department understands climate impacts on missions and is prepared to respond.

TABLE 2. Funding by Climate Line of Effort

	FY 2023 \$ in thousands
Installation Resiliency and Adaptation	1,973,876
Operational Energy and Buying Power	247,095
Science and Technology	806,961
Contingency Preparedness	27,623
Total	3,055,555

The four climate lines of effort are subdivided into categories to appreciate the focus areas within each effort. The category code nomenclature relates the type of funding supporting the lines of effort, as described in the table below:

TABLE 3. Climate Category Fund Types

Climate Change Category Fund Types	
M01-M03	Military construction (including minor MILCON)
O01-O11	Operation and Maintenance
R01-R12	Research and Development
E01-E05	Operational Energy

In the following sections, supporting details of the investments in each climate line of effort are provided.

CLIMATE LINES OF EFFORT

I. INSTALLATION RESILIENCY AND ADAPTATION

Installation Resiliency and Adaptation (\$1,973.9 million) investments are focused on (1) adapting military facilities to withstand increasingly challenging conditions and deploying advanced technologies to strengthen the ability to rapidly recover from disruptions to public infrastructure from climate-induced extreme weather; (2) ensuring the Department can leverage private sector investment to improve installation energy and mission resilience; and (3) modernizing Department operations to keep pace with industry, including the auto sector's rapid shift to electric transportation. Details by climate funding category follow:

- **Renewable energy, storage, micro-grids, efficiency gains, power distribution systems (M01) (\$553.3 million)**

Description: Designated for renewable energy, energy storage, micro-grids or energy or water efficiency improvements, including investments in electric power distribution systems to support deployment.

Funding Details: The \$553.3 million Energy Resilience and Conservation Investment Program (ERCIP) improves the energy resilience and energy and water efficiency at DoD installations. Through ERCIP, DoD is meeting statutory and readiness requirements for installation resilience while also pursuing ways to significantly lower the Department's carbon emissions. The central effort of this program will be to build cyber-secure micro-grids, prioritized by mission requirements. Key components of this program include construction of new, high-efficiency energy systems and the improvement and modernization of existing systems to include clean and renewable energy technologies. The ERCIP program funds construction projects that would not necessarily be candidates for other types of funding, like Operation & Maintenance or third-party financing.

The \$329.0 million in ERCIP major construction funds high-priority, energy/water projects that improve installation resilience from all threats, natural and man-made, and include increased on-site, clean energy production, battery storage, cyber secure micro grids, and improvements to grid capability in order to allow the deployment of Zero Emission Vehicle (ZEV) charging infrastructure.

The \$224.3 million of ERCIP planning and design (P&D) funds planning, architectural, and engineering services required to prepare ERCIP projects for execution. As the Department increases its focus on constructing cyber-secure micro-grids, the scale, scope, and complexity of projects will increase, necessitating an increase in P&D funding. These funds are required to enable the most efficient and effective project execution. This year's P&D funding is increased to help establish a pipeline of projects with more accurate designs, generate more accurate cost estimates, and improve project execution. Funding will support projects that

MEETING THE CLIMATE CHALLENGE

have more complex design requirements, to include cyber, measurement and verification, and infrastructure to support ZEV charging.

Climate Effort Title	Climate		Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
	Category	Account Title				
Installation Resiliency and Adaptation	M01	Military Construction, Defense-Wide	Major Construction	Energy Resilience and Conserv. Invest. Prog.	0904903D	329,000
			Planning & Design	ERCIP Design	0901211D	224,250
Total						553,250

- **Increase installation resilience for impacts of climate change (M02) (\$7.0 million)**

Description: To increase resilience or address impacts or expected impacts of climate change, including sea level rise, drought, or extreme weather.

Funding Details: The \$7.0 million in Military Construction, Defense-Wide funding will provide for updated standards and criteria and provide advanced planning and design to improve installation resilience to climate change impacts. This military construction addresses both built and natural infrastructure. Built infrastructure serves as the staging platform for the Department’s national defense and humanitarian missions. Natural infrastructure supports military combat readiness by providing realistic operational testing and combat environments and conditions. Installations and their built and natural infrastructure also serve as the platforms from which the DoD cares for its people and projects and sustains forces.

Climate Effort Title	Climate		Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
	Category	Account Title				
Installation Resiliency and Adaptation	M02	Military Construction, Defense-Wide	Minor Construction	Unspecified Minor Construction	0702976S	7,000

MEETING THE CLIMATE CHALLENGE

- **Infrastructure in support of the deployment of non-tactical electric vehicles (M03) (\$23.0 million)**

Description: Investments required to support infrastructure requirements for the deployment of non-tactical electric vehicles.

Funding Details: The \$22.0 million for Army funds the planning and construction of ZEV charging infrastructure on Army installations to accelerate progress toward fielding an all-electric non-tactical light-duty vehicle fleet by 2027.

The \$1.0 million for Air Force funds evaluation of the conversion of the non-tactical vehicle fleet to electric vehicles and installation-level charging infrastructure requirements to support it, as well as improve existing infrastructure. This funding enables the Air Force to move towards a zero-emission vehicle fleet.

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
Installation Resiliency and Adaptation	M03	Military Construction, Army	Minor Construction	Unspecified Minor Construction	0901211A	21,980
		Military Construction, Air Force	Minor Construction	Unspecified Minor Military Construction	0901211F	1,000
					Total	22,980

- **Energy saving performance contracts or utility energy services contracts (O01) (\$476.0 million)**

Description: Energy savings performance contracts (ESPC) and utility energy service contracts (UESC) that enable the execution of climate and energy resilience initiatives.

Funding Details: The \$173.6 million for Army, Army Reserve, and Army National Guard funds existing and projected Army performance contract payments to energy service companies for UESCs and ESPCs at Army installations.

The \$190.6 million for Navy and Navy Reserve funds existing and projected Navy performance contract payments to energy service companies for UESCs and ESPCs at Navy installations. Including the FY 2023 budget request, the Navy’s total portfolio for capital investment is \$1.6 billion for 45 ESPCs and \$294.1 million for 56 UESCs.

The \$3.1 million for the Marine Corps funds existing and projected Marine Corps performance contract payments to energy service companies for UESCs and ESPCs at Marine Corps installations.

MEETING THE CLIMATE CHALLENGE

The \$105.0 million for Air Force funds existing and projected Air Force performance contract payments to energy service companies for UESCs and ESPCs at Air Force installations.

The \$3.7 million in O&M, Defense-Wide for UESCs or ESPCs is to accelerate the execution of performance contracts in support of climate and energy resilience, primarily through the deployment of energy conservation measures on existing buildings. These funds will expand DoD’s capacity to execute performance contracts by adding dedicated staff and engineering capabilities. This enhancement accelerates contract throughput of third-party investment in demand reduction, energy resilience, and clean energy solutions in support of installation mission requirements.

Climate Effort Title	Climate		Budget Activity Title	Line Item Title	Program Element	FY 2023
	Category	Account Title				\$ in thousands
Installation Resiliency and Adaptation	O01	Operation & Maintenance, Army	Operating Forces	Base Operations Support	0202079A	158,851
		Operation & Maintenance, Navy	Operating Forces	Base Operating Support	0703879N	188,940
		Operation & Maintenance, Marine Corps	Operating Forces	Base Operating Support	0206479M	3,054
		Operation & Maintenance, Air Force	Operating Forces	Base Support	0207479F	105,000
		Operation and Maintenance, Defense-Wide	Administration and Service-Wide Activities	Office of the Secretary of Defense	0903399D8Z	3,700
		Operation & Maintenance, Army Reserve	Operating Forces	Base Operations Support	0202079A	7,673
		Operation & Maintenance, Navy Res	Operating Forces	Base Operating Support	0703879N	1,684
		Operation & Maintenance, ARNG	Operating Forces	Base Operations Support	0522079A	7,118
		Total				

MEETING THE CLIMATE CHALLENGE

- **Renewable energy power purchases (O02) (\$102.3 million)**

Description: Management and procurement of renewable and clean energy.

Funding Details: The \$79.8 million for Army funds obligations under existing clean energy power purchase contracts to deliver assured and resilient electricity in support of installation resilience and the 24/7 carbon pollution-free electricity (CFE) objective under the Army Climate Strategy.

The \$14.2 million for Air Force funds obligations under existing renewable energy power purchase contracts, where available, enabling 24/7 CFE in combination with innovative technology solutions.

The \$8.3 million in Working Capital Fund, Defense-Wide funding will support the DoD’s and Defense Logistics Agency (DLA) Energy efforts in renewable energy power purchases, including the Department’s efforts to transition its current U.S. electricity portfolio to 24/7 CFE. By streamlining the management and procurement of the Department’s electricity portfolio, the Department and its Government partners can leverage buying power across the U.S. electricity markets. This funding will also enable increased acquisition throughput of DLA managed utility, energy performance, and commercial contracts for on- and off-site 24/7 CFE electricity initiatives.

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
Installation Resiliency and Adaptation	O02	Operation & Maintenance, Army	Operating Forces	Base Operations Support	0202079A	58,990
		Operation & Maintenance, Army	Operating Forces	Facilities Sustainment, Restoration & Modernization	0202176A	20,773
		Operation & Maintenance, Air Force	Operating Forces	Base Support	0207479F	14,200
		Working Capital Fund, Defense-Wide	Energy Management - Defense	Energy Management - Def	0708205DS	8,300
Total						102,263

MEETING THE CLIMATE CHALLENGE

- **Deploy renewable energy, energy storage, or energy/water efficiency gains (O04) (\$296.1 million)**

Description: Deploy renewable energy, energy storage, and energy or water efficiency improvements to increase installation resilience and modernize infrastructure.

Funding Details: The \$199.2 million for Army, Army Reserve and Army National Guard funds renewable energy, energy storage, and energy and water efficiency improvements to support installation resilience, reduce energy and water consumption and related supply chain vulnerabilities, and reduce installation greenhouse gas emissions.

The \$33.9 million for Navy will support facility consolidation efforts, advanced metering initiatives, and the Utilities Infrastructure Condition Assessment Program (UICAP).

The \$16.9 million for Marine Corps will modernize infrastructure to ensure an adequate and dependable energy and water supply to support the operating forces, reduce dependence on external suppliers, increase on-site storage and generation assets, and minimize energy and water consumption. These include:

- \$15.8 million for base operations support and facilitates sustainment, restoration and maintenance projects to repair improve water and electrical systems at Marine Corps Air Station (MCAS) Yuma, Arizona; Marine Corps Recruiting Depot (MCRD) San Diego, California; Marine Corps Air Ground Combat Center Twentynine Palms, California; Marine Corps Base Hawaii; MCAS Iwakuni, Japan; MCAS Cherry Point, North Carolina, and MCRD Parris Island, South Carolina. These investments will improve efficiency while also supporting resiliency.
- \$0.9 million for Family of Mobile Power Systems to maintain program operational readiness for mobile power generation, storage, and distribution systems and environmental control equipment necessary to provide continuous, uninterrupted electrical power and climate control in austere environments. Capabilities reduce the Warfighter's energy logistics burden and enable dispersed units to operate longer between refueling iterations by reducing fuel resupply needs, which decreases the exposure to supply line threats, increases combat effectiveness, and saves lives.
- \$0.2 million for Medium Tactical Vehicle Replacement (MTVR) to support the installation and sustainment of fuel efficient modifications to the MTVR Program. The continued installation of these modifications onto the MTVR Family of Vehicles will further increase the overall fuel efficiency of the fleet.

The \$36.2 million for Air Force enables increased energy and climate resilience through greater resource efficiency by establishing renewable energy paired with battery energy storage systems to meet mission requirements.

The \$7.8 million for the Office of the Secretary of Defense will provide the Department the planning tools, analytic capabilities and coordination mechanism required to deploy advanced energy systems across the enterprise. These funds will enable and

MEETING THE CLIMATE CHALLENGE

integrate the deployment of resilient energy solutions from a variety of funding sources to include; ERCIP, ESPC/UECCs and power purchase agreements.

The \$2.2 million for Washington Headquarters Services (WHS) supports the Department’s priority to protect our workforce while performing our national security mission. Funding supports space reconfiguration for tenant consolidation within spaces leased by WHS on behalf of other DoD agencies.

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands		
Installation Resiliency and Adaptation	O04	Operation & Maintenance, Army	Operating Forces	Facilities Sustainment, Restoration & Modernization	0202176A	138,032		
				Operation & Maintenance, Navy	Operating Forces	Base Operating Support	0205079N	9,929
							0208535N	2,000
			0208550N			10,331		
			0703879N			4,597		
		Operation & Maintenance, Marine Corps	Operating Forces	Sustainment, Restoration and Modernization		0203176N	7,000	
					Base Operating Support	0206479M	1,018	
					Field Logistics	0206624M	892	
						0702808M	197	
						0202176M	14,772	
		Operation & Maintenance, Air Force	Service-Wide Activities	Other Servicewide Activities		0905015F	8,300	
					Operation and Maintenance, Defense-Wide	Service-Wide Activities	Facilities Sustainment, Restoration & Modernization	
		Washington Headquarters Services		0903399D8Z				7,757
				0901584D8W				2,167
		Operation & Maintenance, Army Res	Operating Forces	Facilities Sustainment, Restoration & Modernization		0502576A	5,660	
Operation & Maintenance, ARNG	Operating Forces				Facilities Sustainment, Restoration & Modernization	0502276A	55,551	
Total						296,144		

MEETING THE CLIMATE CHALLENGE

- **Resilience improvements impacting climate change (O05) (\$322.1 million)**

Description: Improvements in resilience to the expected impacts of climate change, including sea level rise, drought, or extreme weather.

Funding Details: The \$8.1 million for Army funds installation energy and utility restoration and modernization efforts that adapt systems to withstand climate impacts and maintain installation operations.

The \$108.5 million for Navy funds a wide variety of Facility Sustainment, Restoration and Modernization projects designed to mitigate the impacts of climate change. Projects include erosion control projects and seawall repair. In addition, the Navy will develop, plan, design, and execute additional future environmental resilience projects.

The \$13.2 million funds Marine Corps' natural resources projects that support installation and training resiliency to climate change. This includes natural resources-based solutions to increase carbon sequestration while addressing erosion and sea level rise through riverine and coastal shoreline restoration; land and forest management and habitat conversion of non-forested land to forests to address severe storm events; habitat management and fuels reduction to decrease wildland fire; restore riparian and submerged aquatic vegetation enhancement/restoration; and soil management conservation to increase water retention.

The \$36.0 million for Air Force allows for planning, design and execution of environmental resilience projects. These projects will ensure installations and facilities are climate-responsive and able to adapt to the evolving impacts of climate change, including but not limited to extreme weather events, sea level rise, drought, recurrent flooding, extreme temperatures, and permafrost melt.

The \$10.0 million for the Office of Local Defense Community Cooperation (OLDCC), an independent field activity aligned under the Under Secretary of Defense (Acquisition & Sustainment), maintains several program authorities that assist state and local governments with planning, design, and program implementation of projects that address climate-related and manmade resiliency challenges. The O&M, Defense-Wide funding is for the installation resilience program which responds to climate-related and/or man-made threats that are likely to impair the operational utility of a military installation, range, military training route, special use airspace, or military operations area. Technical and financial assistance is provided to state and local governments to assess the extent of threats, determine plans to mitigate threats, and carry out those plans. The program represents the only DoD source of technical and financial resources for state and local government efforts to partner with local installations to ensure mission readiness and assurance, in light of present or likely resiliency threats. The Military Departments may nominate installations and ranges for this program based upon concerns over installation resilience, or state and local governments may request community planning assistance for studies to address resiliency concerns, including energy resiliency, and community infrastructure resiliency.

MEETING THE CLIMATE CHALLENGE

The \$146.3 million dollars in O&M, Defense-Wide funding will be used to support and expand the Department's Readiness and Environmental Protection Integration (REPI) program. The REPI program, executed in partnership with local communities, funds off-base natural infrastructure projects to address key installation climate risks. These nature-based solutions will be focused on promoting installation resilience, preserving access to critical installation and range assets and capabilities, and enhancing DoD's core training, testing and operational missions. Examples include constructing living shorelines, restoring dunes and wetlands, recharging aquifers and installing storm-water drainage basins, removing hazardous fuels, and conducting prescribed burns. The REPI program will also invest in expanding installation resilience opportunities by building capacity across key areas of strategic importance, including the Indo-Pacific region, to further increase installation and partnership capacity.

This funding also accelerates climate preparedness and resilience through improved understanding of changing conditions. This information is required for installation infrastructure resilience and climate-resilient mission activities through the environmental resilience program, Natural and Cultural Heritage Program (NCHP), emerging chemicals program, and Greenhouse gas (GHG) mitigation program. Anticipated focal areas include regionally specific wildfire and flooding impacts, internal GHG reporting practices and best practices for clean energy transition, carbon sequestration and circular economy practices.

MEETING THE CLIMATE CHALLENGE

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands	
Installation Resiliency and Adaptation	O05	Operation & Maintenance, Army	Operating Forces	Base Operations Support	0202079A	8,066	
		Operation & Maintenance, Navy	Operating Forces	Base Operating Support	0205079N	36,000	
					Base Operating Support	0708053N	2,603
					Sustainment, Restoration and Modernization	0203176N	21,415
					Sustainment, Restoration and Modernization	0806076N	48,500
		Operation & Maintenance, Marine Corps	Operating Forces	Base Operations Support	0208853M	13,186	
		Operation & Maintenance, Air Force	Administration and Service-Wide Activities	Other Servicewide Activities	0905015F	36,000	
		Operation and Maintenance, Defense-Wide	Administration and Service-Wide Activities	Office of the Local Defense Community Cooperation	0901525D8E	10,000	
					Office of the Secretary of Defense	0903399D8Z	146,287
		Total					

- **Deployment of non-tactical electric vehicles (O06) (\$38.8 million)**

Description: Planning, equipment installation and leasing to support non-tactical electric vehicles.

Funding Details: Funding across all accounts will support the planning and installation of Electric Vehicle Support Equipment (EVSE) and leasing non-tactical ZEV. This supports the Department’s efforts to deploy a non-tactical ZEV fleet designed to modernize the Department’s non-tactical vehicle fleet, meet Administration goals, and curtail greenhouse gas emissions.

MEETING THE CLIMATE CHALLENGE

- EVSE projects: New and replacement of EVSE stations (including project planning, design, coordination, and execution).
- ZEVs: Vehicle lease costs (including associated surcharge).
- ZEV/EVSE initiatives: Deployment of telematics, engineering support, and conducting analysis to optimize vehicle location and usage.

Services and Agencies will place orders with the General Services Administration (GSA) to meet all Service requirements while replacing internal combustion engine non-tactical vehicles with ZEVs.

Additionally, \$0.5 million in O&M, Defense-Wide funding will provide for the planning and oversight necessary to coordinate the deployment of non-tactical electric vehicles. This funding focuses on the reinforcement of the electric grid to support the required infusion of ZEV charging infrastructure to meet the requirements to deploy ZEVs over the next five years.

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands		
Installation Resiliency and Adaptation	O06	Operation & Maintenance, Army	Operating Forces	Base Operations Support	0208542A	4,084		
		Operation & Maintenance, Navy	Operating Forces	Base Operating Support	0205079N	500		
						0708542N	2,300	
						Sustainment, Restoration and Modernization	0203176N	12,000
		Operation & Maintenance, Marine Corps	Operating Forces	Base Operating Support	0708542M	1,000		
						Sustainment, Restoration & Modernization	0202176M	5,000
		Operation & Maintenance, Air Force	Operating Forces	Base Support	0208542F	2,400		
						0901279F	11,000	
		Operation and Maintenance, Defense-Wide	Service-Wide Activities	Defense Technology Security Administration	0901532D8T	3		
						Office of the Secretary of Defense	0903399D8Z	500
Total						38,787		

MEETING THE CLIMATE CHALLENGE

- **Climate impact planning; installation master plans / energy plans (O07) (\$114.2 million)**

Description: Planning to address climate impacts, including updates to installation master plans and installation energy plans.

Funding Details: The \$69.8 million for Army, Army Reserve and Army National Guard funds engineering and planning services at installations to update current plans in order to mitigate the effects of increased climate change risks.

The \$17.9 million for Navy enables revised installation master plans to incorporate impacts from climate change, and the development, planning, design, and execution of future projects to address climate impacts.

The \$16.5 million for the Marine Corps will support alignment with Congressional legislation, DoD strategic direction, and Fleet Marine Forces (FMF) requirements targeting climate, energy resilience, and force design. Primary objectives target enhancing the energy security posture of Marine Corps installations, leveraging third-party financing contracts, and accelerating advanced micro-grid deployment.

The \$5.0 million for Air Force furthers the analysis of climate impacts on installations and missions, which is critical to ensuring installation development and installation energy plans effectively address such impacts. Funding will also assist in the implementation of installation climate resiliency plans which are incorporated into installation energy plans.

The \$5.0 million in O&M, Defense-Wide funding will support resilience of energy components to climate related disruptions. This is critical to overall energy resilience, while also improving the ability of installations to respond, recover, and adapt to changing climate. The integration of climate and extreme weather impacts into installation master planning, with particular attention to climate effects such as increasing extreme heat, ice storms, and wildfire, is key to planning future energy resilience measures. This enhanced installation master planning is necessary to continue to enable installations to support the mission in changing climate conditions.

MEETING THE CLIMATE CHALLENGE

Climate Effort Title	Climate	Account Title	Budget Activity		Program Element	FY 2023 \$ in thousands	
	Category		Title	Line Item Title			
Installation Resiliency and	007	Operation & Maintenance, Army	Operating Forces	Base Operations Support	0202079A	34,186	
		Operation & Maintenance, Navy	Operating Forces	Base Operating Support	0204079N	1,703	
						0205079N	1,023
						0206079N	15,196
		Operation & Maintenance, Marine Corps	Operating Forces	Base Operating Support	0206479M	16,540	
		Operation & Maintenance, Air Force	Administration and Service-Wide	Other Servicewide Activities	0905015F	5,000	
		Operation and Maintenance, Defense-Wide	Administration and Service-Wide	Office of the Secretary of Defense	0903399D8Z	5,023	
		Operation & Maintenance, Army Res	Operating Forces	Base Operations Support	0532079A	10,984	
		Operation & Maintenance, ARNG	Operating Forces	Base Operations Support	0522079A	24,587	
Total						114,242	

- Personnel in support of climate change mitigation or adaptation (O09) (\$21.1 million)**

Description: Personnel to accelerate the Department's capabilities to conduct effective, efficient, and immediate climate mitigation and adaptation.

Funding Details: The \$2.1 million for Army funds current staff and additional civilians to increase climate change mitigation and adaptation expertise within the Army's energy and land management offices.

The \$12.9 million for Navy provides manpower to increase energy efficiency expertise within the Navy's energy offices and supports efforts to increase energy efficiency expertise. This includes funding efforts to optimize energy and utilities usage and performance, including energy audits, retro-commissioning, and studies.

MEETING THE CLIMATE CHALLENGE

The \$1.6 million for Air Force provides Headquarters-level personnel to support climate resilience, including planning, evaluating and executing energy resilience, climate-resilience, and carbon-free energy projects based on Executive Orders and law. These positions will support the central management of a variety of initiatives to enable climate resilience and the planning and implementation of new technologies in support of Department climate objectives.

The \$5.5 million in O&M, Defense-Wide funding will add additional personnel to accelerate the Department's capabilities to conduct effective, efficient, and immediate climate mitigation and adaptation. This funding provides staff across the Department to execute various climate programs described throughout this document.

Climate Effort Title	Climate		Budget Activity		Program Element	FY 2023 \$ in thousands	
	Category	Account Title	Title	Line Item Title			
Installation Resiliency and Adaptation	O09	Operation & Maintenance, Army	Administration and Service-Wide Activities	Administration	0902398A	1,623	
				Force Readiness			
			Operating Forces	Operations Support	0202218A	435	
			Operation & Maintenance, Navy	Administration and Service-Wide Activities	Administration	0902398N	7,050
				Operating Forces	Base Operating Support	0205079N	4,851
						0206079N	961
			Operation & Maintenance, Air Force	Operating Forces	Base Support	0901279F	1,600
			Operation and Maintenance, Defense-Wide	Administration and Service-Wide Activities	Office of the Secretary of Defense	0903399D8Z	3,336
						0907388D8Z	1,200
Total						21,056	

- **Renewable energy or energy storage systems (E03) (\$12.9 million)**

Description: Renewable energy or energy storage systems.

MEETING THE CLIMATE CHALLENGE

Funding Details: The \$12.9 million for Army funds carbon sequestration data collection, modeling, and decision support tools for Army’s land holdings. The toolkit will visualize carbon sequestration potential over the military installations’ landscapes, as well as compare predicted carbon sink capacity based on future potential installation management activities.

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
Installation Resiliency and Adaptation	E03	Research, Development, Test & Eval, Army	Advanced Component Development & Prototypes	Environmental Quality Technology - Dem/Val	0603779A	12,924

- **Energy management or measurement software and systems (E04) (\$7.2 million)**

Description: Improve energy management, data availability, and decision support capabilities; improve capacity, capability and efficiency of measurement software and systems.

Funding Details: The \$0.9 million for Army funds data-driven system management and decision support across energy systems to improve reliability and efficiency. O&M functional costs include non-labor program management, business process re-engineering (change management), help desk, system administration, technology refresh, and life cycle upgrades. RDTE functional costs include systems engineering, systems analysis, and software engineering

The \$6.3 million Navy investment will initiate projects to develop higher efficiency Gallium Nitride (GaN) High Power Amplifiers (HPA). GaN HPAs are used in maritime advanced technology radar and surface electronic warfare systems. For radar and electronic warfare systems, this will yield technology to incorporate and integrate in radar and electronic warfare Transmit/Receive Module designs, with a beneficial impact of improved Power Added Efficiency (PAE) for radar systems that result in reduction in power draw from ship’s service electrical power for the same radar performance.

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
Installation Resiliency and Adaptation	E04	Operation & Maintenance, Army	Operating Forces	Base Operations Support	0202079A	587
		Operation & Maintenance, Navy	Operating Forces	Ship Depot Operations	0708020N	2,263
		Research, Development, Test & Eval, Army	System Development &	Information Technology Development	0605013A	303
		Research, Development, Test & Eval, Navy	System Development &	Air and Missile Defense Radar (AMDR) System	0604522N	2,000
				Ship Self Defense (Engage: Soft Kill/EW)	0604757N	2,000
Total						7,153

MEETING THE CLIMATE CHALLENGE

II. OPERATIONAL ENERGY AND BUYING POWER

Operational Energy and Buying Power (\$247.1 million) includes investments to optimize the use of operational energy and increase combat capability in the legacy aircraft fleet. Investments are aimed at gaining capability and reducing logistics supply requirements for deployed forces and digital flight planning tools, programs to optimize turbine engine compressor performance, and aircraft drag reduction technologies. Details by climate funding category follow:

- **Energy efficiency gains, existing platform (vehicles, ships and airplanes) (E01) (\$75.6 million)**

Description: Operational energy efficiency improvements to existing platforms, including tactical vehicles, ships and airplanes.

Funding Details: The \$59.8 million for Air Force funds operational energy investments to modify in-service aircraft with commercially-proven drag reduction technologies, modernizing the 21st century mission planning software and engine sustainment technology. This will improve aircraft performance, increase aircraft efficiency, and reduce maintenance and sustainment costs.

The \$8.6 million for Navy funds \$1.3 million in operational energy upgrades provides modernizations for Littoral Combat Ship (LCS) propulsion systems and \$7.3 million in research and development efforts for the Navy's Integrated Power System (IPS). Similar to what is on the Zumwalt-class destroyers, the IPS would use all the ship's engines to produce electricity for propulsion, weapon systems, and sensors.

The \$7.9 million for the Marine Corps Medium Tactical Vehicle Replacement (MTVR) Family of Vehicles focuses on the next generation vehicle which will provide significant improvements in fuel efficiency and vehicle hybrid electrification in order to reduce dependence on petroleum fuels. The funding request in FY 2023 will support industry studies to inform requirements documentation in support of competitive prototyping commencing in FY 2024.

MEETING THE CLIMATE CHALLENGE

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
Operational Energy and Buying Power	E01	Operation & Maintenance, Air Force	Administration and Service-Wide Activities	Other Servicewide Activities	0905015F	14,900
			Operating Forces	US NORTHCOM/NORAD	0201130F	2,400
			Other Procurement, Navy	Ships Support Equipment	LCS In-Service Modernization	0204230N
		Procurement, Marine Corps	Support Vehicles	Motor Transport Modifications	0206315M	7,192
		Aircraft Procurement, Air Force	Modification of Inservice Aircraft	C-130	0401115F	17,500
				KC-135	0401218F	19,500
				C-17A	0401130F	5,500
		Research, Development, Test & Eval, Navy	Advanced Component Development &	Navy Energy Program	0603724N	7,340
		Total				

- **Electric / hybrid propulsion systems (vehicles, ships, airplanes) (E02) (\$161.0 million)**

Description: Electric or hybrid electric propulsion systems, including systems for tactical vehicles, ships, and airplanes.

Funding Details: The \$52.7 million for Army funds the design, prototype and testing of electrification efforts for the Joint Light Tactical Vehicle (JLTV) and Family of Medium Tactical Vehicles (FMTV) to include Tactical Vehicle Electrification Kits (TVEK) for both systems, Transmission Integrated Generators (TIG) for FMTV, and development of Hybrid Electric engineering change proposals.

The \$13.5 million for Marine Corps programs include the Family of Mobile Power Systems, Family of Medium Tactical Vehicle Replacement, and Family of Expeditionary Fuel Systems. The development and fielding of these equipment sets are related to enabling the persistence of distributed forces operating in a contested environment. These systems also create a demand reduction benefit, reducing overall GHG emissions of ground forces. In FY 2023, the Marine Corps begins development of the replacement for its legacy Medium Tactical Vehicle Replacement (MTVR) Family of Vehicles (FoV). The Key Performance Parameters (KPPs) for the next generation vehicle, Medium Tactical Truck (MTT) FoV, will require significant improvements in fuel efficiency and vehicle hybrid electrification in order to reduce dependence on petroleum fuels and associated logistics. The

MEETING THE CLIMATE CHALLENGE

MTT FoV will have an improved operational reach while maintaining operational effectiveness and suitability. FY 2023 activities will focus on studies to assess the readiness of industry to meet the Marine Corps’ needs and identify opportunities to improve the KPPs. The FY 2023 activities will inform requirements documentation in support of competitive prototyping commencing in FY 2024.

The \$94.8 million for Navy’s Integrated Power System (IPS), similar to what is on the Zumwalt-class destroyers, would use all the ship’s engines to produce electricity that turns the propellers and powers the weapons and sensors.

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
Operational Energy and Buying Power	E02	Other Procurement, Army	Tactical and Support Vehicles	Modification Of In Svc Equip	0216300A	21,154
			Engineer and Other Equipment	Tactical Fuel Systems	0206315M	1,500
		Research, Development, Test & Eval, Army	System Development & Demonstration	Joint Light Tactical Vehicle (JLTV) Engineering and Manufacturing	0605812A	9,376
				Medium Tactical Vehicles	0604604A	22,163
		Research, Development, Test & Eval, Navy	Advanced Component	Advanced Surface Machinery Systems	0603573N	94,800
			Operational Systems Development	Marine Corps Combat Services Support	0206624M	12,000
Total						160,993

- **Carbon sequestration (O11) (\$10.5 million)**

Description: Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide.

Funding Details: The \$10.5 million for Navy will fund priority projects, such as wetland and forest restoration, that increase base resiliency. It will also support prototyping, integrated testing, and scaled removal of carbon dioxide.

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
Operational Energy and Buying Power	O11	Operation & Maintenance, Navy	Operating Forces	Base Operating Support	0708053N	10,500

MEETING THE CLIMATE CHALLENGE

III. SCIENCE AND TECHNOLOGY

Science and Technology (\$806.9 million) includes investments in basic and applied research and technology prototyping to keep the U.S. military at the cutting edge. This includes investments to accelerate development of hybrid tactical vehicles to strengthen capability through extended range and persistence, silent watch, and the ability to support advanced weapons. Investments also support the prototyping of new platforms like blended wing body aircraft that have the potential to provide capability through increases in range and payload while improving efficiency. S&T also includes investments in climate modeling and technologies like advanced energy storage, fuel cells, and energy management systems. Details by climate funding category follow:

- **Renewable energy (R01) (\$37.9 million)**

Description: Assess and develop renewable energy sources and alternative energy solutions.

Funding Details: The \$36.3 million for Space Force funds the assessment of renewable energy capabilities, such as renewable-powered micro-grids with battery energy storage systems and geothermal technology, meeting 24/7 mission requirements and enabling demonstration and development of prototypes.

The \$1.0 million for DLA's energy readiness program includes collaboration with the DLA military partners for research in alternative energy solutions and climate change initiatives relating primarily to bulk fuel. Research includes the conversion of renewable materials to useable energy, such as investigating waste-based feedstocks for sustainable aviation fuel production.

The \$0.6 million for DoD Enterprise Energy Information Management (EEIM) will provide funding for the Military Aviation and Installation Assurance Siting Clearinghouse program to enhance review process efficiencies as the demand for renewable energy increases. It is an objective of the DoD to ensure that robust development of renewable energy sources and the increased resiliency of the commercial electrical grid may move forward in the United States, while minimizing or mitigating any adverse impacts on military operations and readiness. The Siting Clearinghouse operates under Title 10, Sec 183A, to assess energy projects so as to minimize or avoid degradation of military missions.

MEETING THE CLIMATE CHALLENGE

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands	
Science and Technology	R01	RDTE, Space Force	Advanced Component Development & Prototypes	Space Rapid Capabilities Office	1206857SF	36,285	
			Research, Development, Test & Eval, DW	Advanced Technology Development	Generic Logistics R&D Technology Demonstrations	0603712S	1,020
			System Development & Demonstration	DoD Enterprise Energy Information Management (EEIM)	0305304D8Z	637	
					Total	37,942	

- **Energy Storage (R02) (\$30.6 million)**

Description: Advanced energy storage and battery development.

Funding Details: The \$23.8 million for Army funds research on efficient power, advanced energy storage, innovative power generation and alternative energy technologies for individual Soldier and Squad equipment, as well as fundamental research in power, energy conversion, and fuel efficiency concepts to improve lethality.

The \$5.4 million for Navy funds the battery development safety program that focuses on the safe implementation and fielding of high energy batteries through a rigorous certification process.

The \$1.4 million for Defense-wide supports Defense Logistics Agency’s manufacturing technology in the battery network program, which conducts advanced battery manufacturing research in materials and processes that improve performance, improve efficiency, reduce cost, and reduce harmful waste and impact on the environment. Key areas of research include: light-weight, advanced bipolar lead-acid batteries; designing and testing advanced battery capabilities to replace nickel-cadmium batteries.

MEETING THE CLIMATE CHALLENGE

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands	
Science and Technology	R02	Research, Development, Test & Eval, Army	Advanced Technology Development	Soldier Lethality Advanced Technology	0603118A	4,189	
			Applied Research	Soldier Applied Research	0602184A	2,387	
				Soldier Lethality Technology	0602143A	6,291	
			Basic Research	Defense Research Sciences	0601102A	10,927	
			Research, Development, Test & Eval, Navy	Advanced Component Development & Prototypes	Navy Energy Program	0603724N	5,428
			Research, Development, Test & Eval, DW	Advanced Technology Development	Manufacturing Technology Program	0603680S	1,359
Total						30,581	

- **Fuel Cells (R03) (\$0.9 million)**

Description: Fuel cell development.

Funding Details: The \$0.9 million for Navy funds microbial fuel cells (MFCs), an energy resource that can operate in marine sediments and provide underwater power. Microbes present in the environment use organic matter in the sediment to generate electricity capable of powering undersea devices and sensors for environmental monitoring. This program aims to develop technologies to increase the power density of these devices.

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
Science and Technology	R03	Research, Development, Test & Eval, Navy	Applied Research	Warfighter Sustainment Applied Research	0602236N	869

MEETING THE CLIMATE CHALLENGE

- **Low carbon fuels (R04) (\$7.3 million)**

Description: Development of low carbon fuels, including hydrogen, as a substitute for traditional fossil fuels.

Funding Details: The \$7.3 million for Navy funds advanced the mobility fuels program which is responsible for the development and sustainment of qualification protocols, testing and analysis and coordination with between Navy, other DoD entities, industry, and international partners to qualify the use of Low Carbon Tactical Fuels, both aircraft and ship, for Naval Tactical applications. The Navy procures 1 billion gallons of tactical fuels per year. This effort will position the Navy to procure low carbon tactical fuels, keep pace with global markets to ensure operational flexibility, and, as production increases, take advantage of significant reductions in life-cycle GHG emissions (estimated at over 50 percent) with no impact to platform performance or durability.

Climate Effort Title	Climate		Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
	Category	Account Title				
Science and Technology	R04	Research, Development, Test & Eval, Navy	Advanced Component Development & Prototypes	Navy Energy Program	0603724N	7,277

- **Improving energy efficiency of platforms, operations or installations (R05) (\$317.0 million)**

Description: Improving energy efficiency of platforms, operations or installations.

Funding Details: RDT&E funding across all appropriations supports research and deployment activities to enhance both installation energy performance and resilience as well as providing technical solutions that promote long-term operational energy solutions and military capability in accordance with the Department’s operational energy strategy.

The \$5.5 million for Army funds new materials, devices, and architectures to increase the battery life of Soldier radios and electronic equipment while providing low signature transmissions to enable Soldier survivability.

The \$43.2 million in Navy funding will expedite maturation and implementation of efficiency technologies such as micro-vanes, refueling drogue stabilization, engine wash, blade coatings, and mission planning to increase the efficiency of Naval aircraft.

MEETING THE CLIMATE CHALLENGE

The program will improve engine specific fuel consumption, increase aircraft time on station and/or range, and reduce time and fuel needed to aerial refuel in non-optimal weather conditions.

The Navy Shore Energy Technology Transition and Integration program tests, evaluates, validates, and transitions innovative energy technologies to shore facilities that demonstrate cost-effectiveness and technical viability of energy security, efficiency, resiliency, and reliability. The program supports energy goals to reduce the Department of Navy's reliance on fossil fuels, decrease energy-related strategic vulnerabilities (especially island and forward operating bases), demonstrate sustainability features for new and existing facilities, and reduce the logistic tail for forward operating bases.

The \$4.8 million for Marine Corps' Family of Mobile Power Systems consists of a wide range of current and emerging technologies for mobile power generation, storage, and distribution systems and environmental control equipment necessary to provide continuous, uninterrupted electrical power and climate control in austere and expeditionary advanced base operations environments.

The \$21.0 million in Air Force funding supports improving flight line energy efficiency, by enabling the determination of appropriate energy efficiency improvements needed to meet mission requirements and climate related goals. This includes investments in state-of-the-art software, employing engine sustainment technologies to improve performance, increased use of simulation and augmented reality systems, and energy-aware behavior reducing unnecessary fuel consumption.

The \$38.8 million for the Environmental Security Technology Certification Program (ESTCP) is to accelerate the deployment of innovative technologies that improve installation energy efficiency and security. The program, working closely with the Department of Energy and across all DoD labs, demonstrates and transitions technologies focused on component and system efficiency, solutions to reduce the time and cost to implement and operate micro-grids, and improved planning and design for installation energy resilience projects.

The \$44.2 million for the Operational Energy Capability Improvement – Non-S&T (Operational Energy Prototyping Fund) is intended to help bridge the valley-of-death for prototyping successful operational energy technology development ahead of transition to a Service program. This program was directed by Congress in FY 2020 to improve the demonstration of operational energy technology and validating prototyping. The program collects cost and performance data to overcome barriers against employing an innovative technology stemming from concerns regarding technical or programmatic risk and ensures that the Department has time to establish new requirements, where necessary. This will improve the planning, programming, and budgeting for technology transition to programs of record, thus increasing warfighter transition speed by up to 2-years.

The \$142.8 million for the Operational Energy Capability Improvement Fund (OECIF) is to accelerate the deployment of innovative technologies that improve operational energy efficiency and promote long-term enhancements to military energy capabilities in accordance with the Department's operational energy strategy. This funding includes baseline OECIF funding for

MEETING THE CLIMATE CHALLENGE

powering the force, electrifying the battlespace, commanding energy, and nuclear development. Approximately 70 percent of Services' operational energy consumption is spent on aviation. The increase in baseline funding allows coordinated investment across the Services for aviation efficiencies that was previously not possible.

The \$11.3 million in Advanced Technology Development expands research with clear climate benefits, including reductions in energy usage, greenhouse gas emissions and material waste at the following DoD Manufacturing Innovation Institutes: America Makes, NextFlex, AIM Photonics and BioMade.

The \$1.4 million in the Manufacturing Technology Program supports the Defense Logistics Agency's battery network program to conduct advanced battery manufacturing research in advanced materials and processes. Key areas of research include improving low cost and energy manufacturing technologies, managing specific small business innovation projects, and battery recycling projects.

The \$4.0 million for EEIM will provide funding for the Military Aviation and Installation Assurance Siting Clearinghouse program to enhance review process efficiencies as the demand for renewable energy increases. It is a DoD objective to ensure that the robust development of renewable energy sources and the increased resiliency of the commercial electrical grid may move forward in the United States, while minimizing or mitigating any adverse impacts on military operations and readiness. The Siting Clearinghouse operates under Title 10, Sec 183A requirement to assess energy projects so as to minimize or avoid degradation of military missions.

MEETING THE CLIMATE CHALLENGE

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands		
Science and Technology	R05	Research, Development, Test & Eval, Army	Applied Research Advanced Component Development &	Network C3I Technology	0602146A	5,480		
		Research, Development, Test & Eval, Navy	Applied Research	Navy Energy Program	0603724N	20,946		
				Applied Research	Force Protection Applied Research	0602123N	400	
					Defense Research Sciences	0601153N	21,816	
					Operational Systems Development	Marine Corps Combat Services Support	0206624M	4,836
				Research, Development, Test & Eval, AF	Advanced Component Development & Prototypes	Tech Transition Program	0604858F	14,000
					Operational Systems Development	Aircraft Engine Component Improvement Program	0207268F	1,000
					Software and Digital Technology Pilot Programs	Air & Space Operations Center (AOC) - Software Pilot Program	0608410F	6,000
				Research, Development, Test & Eval, DW	Advanced Component Development & Prototypes	Environmental Security Technical Certification Program	0603851D8Z	38,823
						Operational Energy Capability Improvement - Non S&T	0604555D8Z	44,200
					Advanced Technology Development	Operational Energy Capability Improvement	0604055D8Z	142,800
						Manufacturing Science and Technology Program	0603680D8Z	11,300
						Foreign Comparative Testing	0603133D8Z	40
						Manufacturing Technology Program	0603680S	1,359
					System Development & Demonstration	DoD Enterprise Energy Information Management (EEIM)	0305304D8Z	4,000
					Total	317,000		

MEETING THE CLIMATE CHALLENGE

- **Energy efficient new platforms (R06) (\$177.9 million)**

Description: Applied research and advanced technology development for new platforms.

Funding Details: The \$2.0 million for Army funds modernization of priority future vertical lift and air platforms through development of power dense, fuel efficient, durable propulsion technologies that offer significant improvements in range, speed, and payload lift.

The \$10.5 million for Navy funds the assessment, development, maturation, and transition of power (batteries and fuel cells), thermal management (models and fluid transfer), and engine and airframe efficiency technologies to increase the mission capability of Naval aircraft. The program will increase range and payload capacity of UAVs, significantly reduce time and cost to optimize power and thermal solutions to current aircraft, increase emergency capability, reduce total ownership costs and future non-recurring engineering costs for aircraft batteries, and increase aircraft range and time on station.

The \$10.8 million for the Marine Corps supports development of a variety of technologies including Cold Weather and Mountaineering equipment, Family of Shelters, and the offices that conduct this research. One example is Marine Air-Ground Task Force (MAGTF) Sustainment (Hybrid Expeditionary Power). Systems will be MV-22 transportable and capable of drawing upon multiple power sources (self-generated & scavenged), in order to provide electrical power to an onboard battery bank from which loads will be powered in real-time, or on which power will be stored for future use.

The \$55.0 million for Air Force supports the Service Climate Action Plan to include pursuing energy efficiencies in aircraft, such as the electric vertical take-off and landing (eVTOL) system development to leverage dual-use emerging commercial technologies. One such technology, the Series Hybrid Electric Propulsion Aircraft Demonstrator (SHEPARD), is a step towards aircraft electric propulsion that could prove a pollution free air travel option and increase the energy efficiency of air travel.

The \$22.0 million for Defense Advanced Research Projects Agency (DARPA) also funds the SHEPARD program. The SHEPARD program is designing and developing an efficient hybrid electric propulsion system and integrating it into a unique military aircraft application. The innovative aircraft design will include essential operational considerations and mission system components. The program employs a rapid development framework that capitalizes on maturing mission-enabling technologies to quickly meet emergent mission needs while overcoming significant system-level technical challenges. The result will be a flight-demonstrated system with a minimal viable mission capability that is developed quickly and at relatively low cost.

The \$74.2 million funds the Manta Ray (\$38.7 million) and Sea Train (\$38.7 million) programs:

- The Manta Ray Program is developing and demonstrating a new class of long-duration, long-range unmanned underwater vehicles (UUVs) at an acquisition and lifecycle cost significantly less than current payload-capable UUVs. This new class of UUV will give the combatant commander an amplification of capacity without disrupting current operations by

MEETING THE CLIMATE CHALLENGE

- remaining independent of manned vessels and ports once deployed. The primary goal of the Manta Ray program is to open a design space for future UUVs capable of both long duration missions and large payload capacity. A secondary goal of the program is to advance key technologies benefiting other naval designs such as low lifecycle cost UUV operations, energy management technologies to enable long-duration operations, biofouling reduction technologies, and long-duration navigational enablers. The anticipated transition partner is the Navy. This program is increasing the energy efficiency of undersea travel and enables energy harvesting in the undersea environment to create energy independent underwater vehicles.
- The Sea Train Program is supporting the delivery of masses of unmanned surface vessels into theater, without reliance on large, manned capital assets. The Sea Train program is developing and demonstrating approaches to exploit the efficiencies of longer slender hulls, while enabling a distributed fleet of tactical Unmanned Surface Vessels (USVs). The Sea Train concept enables vessels that are efficient for transoceanic transport while enabling dispersed operations as individual vessels. The Sea Train program is developing and demonstrating connectors and approaches to couple the vessels, the control laws required to drive the vessel in open ocean conditions, sensor approaches to understand the wave environment to efficiently navigate the vessel, and the autonomy required to connect and disconnect the vessels without human intervention. The goal of this effort is to improve transport efficiency over what can be achieved with current mono-hull designs. This allows for the efficient transport of smaller vessels into and out of theater, an operation that is normally accomplished today by carrying smaller vessels on board larger vessels or reliance on at-sea refueling of smaller vessels. The anticipated transition partner is the Navy. This program is investigating novel methods to enable multiple ships to travel in formation to reduce wave making drag and increase energy efficiency of sea travel.

MEETING THE CLIMATE CHALLENGE

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
Science and Technology	R06	Research, Development, Test & Eval, Army	Advanced Technology Development	Future Vertical Lift Advanced Technology	0603465A	2,038
			Advanced Component Development & Prototypes	Navy Energy Program	0603724N	10,486
			Advanced Technology Development	USMC Advanced Technology Demonstration (ATD)	0603640M	6,287
			Applied Research	Marine Corps Landing Force Technology	0602131M	2,039
			Operational Systems Development	Marine Corps Combat Services Support	0206624M	37
				Marine Corps Communications Systems	0206313M	2,054
				Marine Corps Ground Combat/Supporting Arms Systems	0206623M	371
			Advanced Component Development & Prototypes	Tech Transition Program	0604858F	55,000
			Applied Research	Air Platform Applied Research	0602183A	3,414
			Advanced Technology Development	Advanced Aerospace Systems	0603286E	22,000
	Network-Centric Warfare Technology	0603766E	74,219			
Total						177,945

MEETING THE CLIMATE CHALLENGE

- **Electrification of vehicles, ships, and airplanes (R07) (\$147.5 million)**

Description: Operational energy capability improvements funding across all appropriations improves DoD capabilities to meet operational energy objectives and promote long-term enhancements to military energy capabilities in accordance with Department's operational energy strategy.

Funding Details: The \$64.0 million for Army funds the modernization of priority next-generation combat vehicles providing silent watch and mobility, increased operational duration, and more on-board electrical power for ground tactical and combat vehicles through electrification architecture and hybrid electric combat vehicle research.

The \$49.0 million for Navy funds the Naval Platform Operational Endurance & Climate Resiliency Science project to advance design tools focused on climate resilience and predicting emissions from platforms. Pursuing technology development efforts to impact climate remediation, including evaluation of Low Global Warming Potential refrigerants, Subsea & Seabed Warfare Energy Harvesting, and Direct Air Capture & Blue Carbon fuel synthesis. Funding also supports electrical and auxiliary system and component technology to dramatically improve naval capabilities by providing energy and power resiliency. The Navy is looking at energy efficiency and focusing on more than just electrification; investments include disruptive technologies in energy scavenging at the tactical edge, alternative fuels, and energy-efficient small-scale efforts to support the sustainment and logistics of Sailors and Marines deployed in austere environments.

The \$34.5 million for OECIF is to accelerate the deployment of innovative technologies that improve operational energy efficiency and promote long-term enhancements to military energy capabilities in accordance with the Department's operational energy strategy. This funding focuses on common efficiency opportunities for electrification of tactical vehicles and ensures learning and partnership across the services while driving down duplication of efforts.

MEETING THE CLIMATE CHALLENGE

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands		
Science and Technology	R07	Research, Development, Test & Eval, Army	Advanced Technology Development	Ground Advanced Technology	0603119A	552		
				Next Generation Combat Vehicle Advanced Technology	0603462A	46,679		
				Ground Technology	0602144A	2,526		
					Applied Research	Next Generation Combat Vehicle Technology	0602145A	14,226
				Research, Development, Test & Eval, Navy	Applied Research	Force Protection Applied Research	0602123N	49,008
				Research, Development, Test & Eval, DW	Advanced Technology Development	Operational Energy Capability Improvement	0604055D8Z	34,500
					Total	147,491		

- Measurement or modeling of climate impacts (R08) (\$6.3 million)**

Description: Research to improve preparedness with advanced sensing and monitoring of climate data to help reduce negative consequences.

Funding Details: The \$0.4 million for Air Force supports the development of modern weather sensor and components to mitigate risk due to lack of warning of impending severe weather. More accurate weather information integrated into mission planning and execution can reduce fuel consumption, decrease re-attack sorties, and improve mission effectiveness.

The \$4.0 million in RDT&E, Defense-wide funding will improve DoD preparedness to operate in a world impacted by climate change, reducing the likelihood of climatic “surprise” and preserving enduring advantage under all future conditions. These funds will support advancement of capabilities to measure, model, and monitor complex climate interactions at the range of geographic and time scales necessary to enable the Department to operate under changing climate conditions, thus preserving operational capability and enhancing and protecting the natural and man-made systems essential to the Department’s success. Measuring, modeling, and monitoring are key to climate-informed decision-making. Climate data sources must be continuously

MEETING THE CLIMATE CHALLENGE

monitored and updated, with consideration of the operational impact, to account for the rapid rate of climate change and its impacts

The \$1.9 million for Pacific Disaster Centers use applied science and information and technology to reduce worldwide disaster risks and impacts on life, property, and economies.

Climate Effort Title	Climate		Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
	Category	Account Title				
Science and Technology	R08	Research, Development, Test & Eval, AF	Operational Systems Development	Weather Service	0305111F	424
			Applied Research	Social Sciences for Environmental Security	0602675D8Z	4,000
			Operational Systems Development	Pacific Disaster Centers	0708012S	1,875
Total						6,299

- **Climate change-related modeling, simulation, wargames, exercises (R09) (\$16.0 million)**

Description: Advanced demonstrations to collect climate-related data using modeling, simulation, wargames and exercises to identify and understand DoD’s highest priority environmental requirements.

Funding Details: The \$16.0 million for ESTCP increases research supporting rapid application of infrastructure resilience and adaptive measures. The program promotes demonstrations to collect data using analytical tools, techniques and technologies to improve installation infrastructure resilience to climate related threats.

Climate Effort Title	Climate		Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
	Category	Account Title				
Science and Technology	R09	Research, Development, Test & Eval, DW	Advanced Component Development & Prototypes	Environmental Security Technical Certification Program	0603851D8Z	16,000

MEETING THE CLIMATE CHALLENGE

- **Adaptation to climate change (R10) (\$65.6 million)**

Description: Innovation to develop and demonstrate innovative, cost-effective, and sustainable solutions to increase DoD's ability to meet environmental challenges and adapt to climate change. In addition to monitoring and mitigation measures for heat illness in training settings, requirements are increasing for technologies that help reduce Soldier risks from worsened air quality, vector-borne disease, and food-related infections.

Funding Details: The \$1.8 million for Army funds medical technologies that mitigate climate change-related risks to Soldiers. In addition to monitoring and mitigation measures for heat illness in training settings, requirements are increasing for technologies that help reduce Soldier risks from worsened air quality, vector-borne disease, and food-related infections.

The \$3.7 million for Navy funds an effort to improve integration of weather and ocean forecasts into ship routing, ship response and propulsion efficiency planning, and Refueling at Sea logistics planning, as well as prediction of hazardous and extreme weather events and trends for climate adaptation, resiliency, and mitigation.

The \$0.9 million in Air Force funding supports the integration of host nation weather radar data into the United States Air Force data display, interrogation, and exploitation platforms. This funding will greatly improve the forecasting and warning for severe or extreme weather events for defense facilities outside the continental United States.

The \$43.8 million for Defense Advanced Research Projects Agency (DARPA) includes funding for several S&T programs to address innovative approaches to mitigate or adapt to climate change. These include the Atmospheric Water Extraction (AWE), Bio-Inspired Coastal Defense, and Food and Feedstocks on Demand programs:

- The \$14.0 million request for the AWE program supports efforts to enable water harvesting directly from the atmosphere by leveraging new materials and advanced engineering and manufacturing techniques to alleviate the logistical and tactical burden of the water supply chain. Currently, DoD relies on purification of existing water sources or distribution of bottled or treated water to provide the warfighter with sufficient daily hydration. State-of-the-art water-from-air generation systems are not suitable for military applications because the systems do not operate in a range of atmospheric conditions needed by our service members, from arid conditions to extremely humid, and are too energy-intensive. AWE will deliver systems with extraordinarily low size, weight, and power characteristics to provide potable water to individual warfighters, and expeditionary units. Technologies developed under this program will provide strategic and tactical advantages aligned with the DoD's vision of future combat operations carried out by distributed and self-sustaining forces. The AWE program offers an adaptation approach - as climate change leads to greater drought and scarcity of water resources, the program can provide a means to provide potable water to water-stressed populations that become more prevalent as a result of climate change.

MEETING THE CLIMATE CHALLENGE

- The \$12.0 million request for the Bio-Inspired Coastal Defense program supports the development of self-sustaining, hybrid man-made, and biological reef structures to fortify and defend DoD bases in low-lying coastal regions. Military assets in these coastal regions are vulnerable to storm surges, wave action, and sea-level rise that cause erosion, degrade infrastructure, and impede operations. Innovative coastal defense will require major technological advances in (1) design, construction, and placement of manufactured reef primers, (2) accelerated recruitment and/or growth of reef species, and (3) sustained, zero-cost natural maintenance and improvement (e.g., increased durability after challenge) of the defensive reef. The primary benefit of such structures is to attenuate wave height during storm events for both established and under construction coastal facilities.
- The \$17.9 million request for the Food and Feedstocks on Demand program advances the development of biological technologies to support the DoD need to strengthen local resource security for the warfighter. Currently, operators in the field are burdened with transport and disposal of single-use materials. This program is using these burdensome materials as inputs to re-form the molecules for nutrition or other strategic applications. Research in this program will provide a versatile system that delivers food, water, and petroleum, oils, and lubricants (POLs) so that warfighters can independently produce material support to extend mission duration and expand operational flexibility in resource-limited environments. The program is developing technologies that process, deconstruct, and repurpose plastics and other waste products into other useful materials reducing the burden of plastic waste.

The remaining \$15.2 million in RDTE, DW funding is directed toward enhanced knowledge of climate adaptation that will enable the Department to operate under changing climate conditions. Targeted applied science and technology is critical to accelerating climate adaptation across the Department. The Strategic Environmental Research and Development Program and the ESTCP harness the latest science and technology to develop and demonstrate innovative, cost-effective, and sustainable solutions to meet DoD's environmental challenges. These technologies will find direct application by planners and managers to more efficiently prepare installations to avoid disruptions to operations resulting from climate change.

MEETING THE CLIMATE CHALLENGE

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
Science and Technology	R10	Research, Development, Test & Eval, Army	Advanced Technology Development	Medical Advanced Technology	0603002A	1,839
		Research, Development, Test & Eval, Navy	Applied Research	Ocean Warfighting Environment Applied Research	0602435N	3,747
		Research, Development, Test & Eval, AF	Operational Systems Development	Weather Service	0305111F	930
		Research, Development, Test & Eval, DW	Applied Research	Materials and Biological Technology	0602715E	43,849
			Component Development & Prototypes	Environmental Security Technical Certification Program	0603851D8Z	2,446
			Advanced Technology Development	Strategic Environmental Research Program	0603716D8Z	12,746
Total						65,557

MEETING THE CLIMATE CHALLENGE

IV. CONTINGENCY PREPAREDNESS

Contingency Preparedness (\$27.6 million) includes investments to incorporate climate risks into wargames, exercises, and other planning tools to ensure the Department understands climate impacts on missions and is prepared to respond. This includes black-start exercises to identify vulnerabilities and remediate risks to installation power systems. As climate-induced extreme weather is increasing demand for DoD support, Contingency Preparedness investments include support for Humanitarian Assistance and Disaster Relief (HADR) and Defense Support to Civil Authorities (DSCA) activities. Details by climate funding category follow:

- **Modeling, simulation, wargames, exercises (e.g. black start exercises) (O08) (\$21.6 million)**

Description: Exercises, wargames, and simulations to better understand the impact of climate on the strategic environment. Black start exercises to assess installation readiness. Also includes international program for defense-related environmental and operational energy engagement activities.

Funding Details: The \$7.7 million for Navy funds critical infrastructure protection. The program supports all-hazards threat and vulnerabilities assessments across the Shore enterprise.

The \$0.4 million for the Marine Corps is for the Marine Corps Prepositioning Program – Norway that supports the withdrawal of equipment and supplies for ashore prepositioning sites in support of contingency preparedness for cold weather related exercises.

The \$2.5 million for Air Force supports efforts for black-start exercises to assess that our installations are ready and capable of withstanding utility disruptions caused by extreme weather or malevolent acts. These exercises highlight needed utility improvements to support mission assurance, energy resilience, and climate-response

\$3.0 million in O&M, DW funds the Defense International Environmental Program (DEIC) to work with international partners on defense-related environmental and operational energy engagement activities. DEIC also supports international engagement in pursuit of the strategic end states identified in the Secretary of Defense’s Guidance for the Employment of the Force as well as the Combatant Command’s Theater Campaign Plans.

The \$8.0 million for the Joint Training Exercise and Evaluation Program (JTEEP), formerly Combatant Commander Exercise Engagement and Training Transformation (CE2T2), funds Joint Exercises at Combatant Commands and incorporates joint context into Service training programs. The FY 2023 funding request for JTEEP builds on FY 2022 investments for climate change to support climate and severe weather-related exercises. In FY 2023, funding will be applied to SOUTHCOM and NORTHCOM exercises. The SOUTHCOM exercises, CENTAM GUARDIAN and RESOLUTE SENTINEL, will improve combined responsiveness with partners to execute humanitarian assistance and disaster recovery due to changing climate conditions. Funding applied to NORTHCOM exercises will improve efforts to prepare for Arctic Homeland Defense operations

MEETING THE CLIMATE CHALLENGE

under severe climate conditions. This funding will help shape the strategic environment in ways favorable to U.S. and Allied interests and influence Joint Force design to address the full spectrum of emerging and future military requirements.

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
Contingency Preparedness	O08	Operation & Maintenance, Navy	Operating Forces	Cyberspace Activities	0305125N	7,626
				Ship Operations Support & Training	0202056N	55
		Operation & Maintenance, Marine Corps	Operating Forces	Maritime Prepositioning	0206480M	441
				Other Servicewide Activities	0905015F	2,500
		Operation and Maintenance, Defense-Wide	Administration and Service-Wide Activities	Office of the Secretary of Defense	0907388D8Z	3,000
				Joint Chiefs of Staff - JTEEP	0804768J	8,000
Total						21,622

- HADR and DCSA for extreme weather events (O10) (\$6.0 million)**

Description: Humanitarian Assistance and Disaster Relief and Defense Support to Civil Authorities for extreme weather events.

Funding Details: The \$1.1 million for Air Force enhances the Artificial Intelligence and Machine Learning Global Synthetic Weather Radar project to reduce gap coverage of global radar mosaics and mitigate risk due to lack of warning of impending severe weather. These modernization efforts will enhance capability for the timely identification of environmental events impacting military operations globally. Funding will also ensure proper sustainment of climate services at higher enclaves to Combatant Commands, the Intelligence Community, advanced acquisition programs, and planning communities. It also includes necessary cybersecurity oversight to protect defense information systems from cyber threats.

The \$4.9 million is for Pacific Disaster Centers that is an applied research center managed by the University of Hawaii that develops new technologies and best practices to advance the field of disaster mitigation, preparedness, response and recovery. PDC supports the most demanding needs of nonprofits and government organizations worldwide to create a safer, more disaster

MEETING THE CLIMATE CHALLENGE

resilient world through its DisasterAWARE geospatial information technology platform that provides early warning, hazard monitoring; and impact estimation for decision makers.

Climate Effort Title	Climate Category	Account Title	Budget Activity Title	Line Item Title	Program Element	FY 2023 \$ in thousands
Contingency Preparedness	O10	Operation & Maintenance, Air Force	Operating Forces	Global C3I and Early Warning	0305111F	1,122
		Operation and Maintenance, Defense-Wide	Administration and Service-Wide Activities	Defense Logistics Agency	0708012S	4,879
					Total	6,001

MEETING THE CLIMATE CHALLENGE

CLIMATE BUDGET BACKUP EXHIBITS

TABLE 4. Climate Funding by Appropriation

Appropriation	FY 2023 \$ in thousands
Operation & Maintenance, Army	425,627
Operation & Maintenance, Navy	397,343
Operation & Maintenance, Marine Corps	56,100
Operation & Maintenance, Air Force	232,363
Operation and Maintenance, Defense-Wide	195,852
Operation & Maintenance, Army Res	24,317
Operation & Maintenance, Navy Res	1,684
Operation & Maintenance, ARNG	87,256
Other Procurement, Army	21,154
Other Procurement, Navy	1,270
Procurement, Marine Corps	8,692
Aircraft Procurement, Air Force	42,500
Research, Development, Test & Eval, Army	145,314
Research, Development, Test & Eval, Navy	253,741
Research, Development, Test & Eval, Air Force	77,354
Research, Development, Test & Eval, Space Force	36,285
Research, Development, Test & Eval, DW	457,173
Military Construction, Army	21,980
Military Construction, Air Force	1,000
Military Construction, Defense-Wide	560,250
Working Capital Fund, Defense-Wide	8,300
Grand Total	3,055,555

MEETING THE CLIMATE CHALLENGE

TABLE 5. Climate Funding by Line of Effort and Category

Climate Lines of Effort	Climate Categories	Climate Category Code	FY 2023 \$ in Thousands
Installation Resiliency and Adaptation	Renewable energy, Storage, Microgrids, Efficiency Gains, Pwr Distr Systems	M01	553,250
	Increase installation resilience for impacts of climate change	M02	7,000
	Infrastructure ISO the deployment of non-tactical electric vehicles	M03	22,980
	ESPC or UESC	O01	476,020
	Renewable Energy Power Purchases	O02	102,263
	Deploy renewable energy, storage, energy/water efficiency gains	O04	296,144
	Resilience improvements impacting climate change	O05	322,057
	Deployment of non-tactical electric vehicles	O06	38,787
	Climate impact planning; installation master plans / energy plans	O07	114,242
	Personnel ISO climate change mitigation or adaptation	O09	21,056
	Renewable energy or energy storage systems	E03	12,924
	Energy management or measurement software and systems	E04	7,153
	Installation Resiliency and Adaptation total		
Operational Energy and Buying Power	Energy efficiency gains, existing platform (vehicles, ships and airplanes)	E01	75,602
	Electric / hybrid propulsion systems (vehicles, ships, airplanes)	E02	160,993
	Carbon sequestration.	O11	10,500
Operational Energy and Buying Power total			247,095
Science and Technology	Renewable energy	R01	37,942
	Energy storage	R02	30,581
	Fuel cells	R03	869
	Low carbon fuels, including hydrogen	R04	7,277
	Improving energy efficiency of platforms, operations or installations	R05	317,000
	Energy efficient new platforms	R06	177,945
	Electrification of vehicles, ships, and airplanes	R07	147,491
	Measurement or modeling of climate impacts	R08	6,299
	Climate change-related modeling, simulation, wargames, exercises	R09	16,000
	Adaptation to climate change	R10	65,557
Science and Technology total			806,961
Contingency Preparedness	Climate change modeling, simulation, wargames, exercises (e.g. black start exercises)	O08	21,622
	HADR and DCSA for extreme weather events	O10	6,001
Contingency Preparedness total			27,623
Grand Total			3,055,555