

## FY 2022 DOE Renewable Energy and Energy Efficiency Priorities

The Department of Energy (DOE) proposed \$4.7 billion, an increase of \$1.9 billion or 65 percent, for renewable energy and energy efficiency research, development, deployment, and demonstration activities in fiscal year (FY) 2022. While congressional appropriations will determine final funding levels, DOE still plans to advance new programmatic priorities. A significant portion of new proposed funding is for industry- and DOE national lab-led projects. This analysis highlights new initiatives and funding opportunities of most relevance to research universities and other research organizations. A separate analysis was provided on new advanced manufacturing research, development, and demonstration initiatives.

### Vehicle Technologies

- **\$66 million for battery research and development:** DOE supports research and development of high-energy and high-power battery materials, cells, and battery development to significantly reduce the cost, weight, volume, and charge time of plug-in electric vehicle batteries. DOE plans to expand research efforts focused on next-generation lithium ion and other chemistries, including silicon-based anodes, novel liquid electrolyte formulations, low and/or no cobalt cathode materials, lithium metal anodes, sulfur-based cathodes, and solid-state electrolyte materials. The highest priority research area will be solid-state material systems that can meet key performance metrics for weight, volume, and cost, while achieving further improvements in cycle life. DOE also plans to initiate new cooperative research agreements for lithium metal and solid-state battery materials scale up including processing and cell development and expanding participation in the Battery500 R&D Consortium.
- **\$20 million for a new Clean Energy Mobility Solutions for Underserved Communities initiative:** DOE plans to launch a new research initiative to design transportation solutions that meet the needs of various underserved populations, including those in energy communities, and to conduct pilot demonstrations to evaluate their effectiveness. Research efforts would explore a variety of mobility solutions, such as improving public transportation (access, affordability, efficiency, convenience), implementing new last-mile services and modes (micromobility, automated point-to-point transportation), and other connected and automated transportation technology solutions for both urban and rural communities. Demonstrations would focus on zero carbon emission/electric transportation solutions and include participation from members of the community to address their specific needs.
- **\$12 million for lightweight materials:** DOE supports research and development in advanced high-strength steels, aluminum alloys, magnesium alloys, carbon fiber composites, and multi-material systems with potential performance and manufacturability characteristics that greatly exceed today's technologies. DOE plans to compete and award new projects on multi-functional materials, including polymer matrix composites, to reduce the cost, weight, and volume of electric vehicle batteries and support the transition to electric light duty vehicles. DOE also plans to fund a new research effort on non-exhaust emissions (tire wear, brake wear, road wear, and stirred up dust) which contribute more particulate matter particles than exhaust emissions. DOE also plans to address knowledge gaps in the specific contributions of vehicle non-exhaust emission sources in the U.S. and their health effects. DOE has found that adverse health effects have been correlated to increased exposure to particulate matter that is present near roadways and in urban environments with stop and go traffic, representing an environmental injustice to the communities located in those areas.

- **\$9 million for powertrain materials:** DOE supports research and development for higher performance materials to address the future properties and needs of electric and hydrogen fuel cell vehicles to increase efficiency and decrease manufacturing cost, supporting the transition to all electric light duty vehicles by 2035. DOE plans to fund a new research effort on affordable, recyclable, high conductivity materials for lightweight electric powertrain components. DOE also plans to fund a new research effort to address the materials property requirements of challenging electric vehicle powertrain components such as inverters, motors, and gear-trains. Key challenges include electrical conductivity, thermal conductivity, magnetic materials, and high temperature operation currently limiting advances in electric powertrain and wireless charging.

### Bioenergy

- **\$10 million for a new research and development program on biogenic carbon drawdown, soil carbon sequestration, and bioenergy with carbon capture and sequestration:** DOE's new focus is on the interface of carbon management and how sustainable agriculture and forestry can advance climate priorities.

### Fuel Cell Technologies

- **\$10 million for materials and components:** DOE supports research and development activities needed to make a membrane electrode assembly (MEA), as well as other stack components. DOE's primary areas of focus include catalysts, electrodes, membranes, ionomer, bipolar plates, and gas diffusion layers, as well as advances in modeling and MEA manufacturing approaches. In FY 2022, DOE plans to advance research and development efforts beyond early-stage concepts, including manufacturing processes, funded at research universities. DOE plans to shift the focus to components beyond catalysts, including gas diffusion layers, to reduce dependence on imports and strengthen the domestic supply base.

### Solar Energy

- **\$36 million for manufacturing:** DOE supports efforts focused on developing and validating new solar technologies which can be domestically manufactured. This includes the full value chain, from innovative approaches to producing solar cells and module materials to new tracking technologies to power electronics to technologies to reduce maintenance costs. DOE plans to fund new projects to develop and scale new solar cells and materials, manufacturing processes and products, supply chain integrations, and building-integrated photovoltaics/photovoltaic building materials which can lead to increased domestic manufacturing across the solar value chain.
- **\$15 million for solar thermochemical reactors:** DOE supports research and development of industrial processes driven by solar thermal energy, including the development of solar thermal pathways for the carbon-emission-free production of energy-intensive chemicals, commodities, and fuels, like ammonia, steel, cement, and hydrogen. DOE plans to increase funding for projects that can develop solar thermochemical processes and components for the production of solar-derived industrial products, chemicals, and fuels to enable decarbonization of the full energy sector by 2050.
- **\$5 million for increased durability:** In the FY 2022 annual photovoltaics funding solicitation, DOE plans to increase funding for research and development focused on extreme weather and hardening of photovoltaic systems for increased resilience.

## Wind Energy

- **\$42 million for wind energy grid integration:** DOE supports new technologies and analytical tools that facilitate transmission access and improve grid reliability and resiliency with increasing levels of wind energy. The majority of this funding will support industry- and national lab-led projects but there are opportunities for research university partnerships. DOE plans to fund new activities in FY 2022 including new research to assess transmission infrastructure requirements to maintain system reliability and ensure cost-effective transmission access for offshore wind, while identifying innovative solutions to provide advanced grid services and reduce costs; in partnership with DOE's Hydrogen and Fuel Cell Program demonstrate a multi-megawatt water electrolyzer coupled with wind power generation to produce low-cost, emissions-free hydrogen; in partnership with DOE's Solar Energy Technologies Office demonstrate the robustness of grid services provided by utility scale wind and solar plants under various operating conditions and develop a roadmap to enable faster and simpler interconnection of solar and wind resources to the electric grid; and demonstrate and validate hybrid wind energy storage technologies.
- **\$20 million for offshore wind manufacturing and materials research and development:** DOE supports research and development to reduce the technical challenges of installing offshore wind turbines by reducing turbine weight, finding turbine installation methods that do not require large European-type installation vessels, and using advanced materials and manufacturing technologies to reduce the fabrication costs of floating offshore turbine foundations. In FY 2022, DOE plans to initiative a new research initiative on advanced materials and manufacturing research and development to reduce full lifecycle costs and accelerate blade/tower/nacelle factory throughput. This would include new manufacturing methodologies using additive manufacturing techniques coupled with automated assembly approaches to reduce fabrication costs and mitigate transportation challenges of large and complex wind turbine components. The goal is to address existing challenges for wind, such as enabling continued scaling and light weighting, improving turbine reliability, using advanced manufacturing and better designs to overcome transportation constraints, and overcoming materials and supply chain issues. DOE also plans to launch a Wind Re-design for Recycling initiative to improve recycling and recovery of critical materials at wind plants end of life. The initiative would focus on recycling existing components and re-design for future components as well as using novel materials and manufacturing ("design for recycling") to extend life and make it economically more cost effective to recycle in the future. The goal is to reduce demand for critical materials in wind turbines.
- **\$18 million for offshore wind science and technology innovation:** DOE supports new offshore wind technologies that can open new markets, such as deep-water markets on the West Coast of the U.S., by developing floating technologies, supporting designs optimized for domestic supply chains, and advancing turbine and farm controls to increase output and improve predictability. DOE is also interested in how operations can be optimized and how operations and maintenance (O&M) costs decreased with the proper tools and data to decrease unplanned maintenance and extend the lifetime of components, especially in the harsh offshore environment. In FY 2022, DOE plans new investments in O&M optimization for larger turbines through prognostic health management tools, standardized data, remote and autonomous advanced inspection and fault detection, and repair techniques supported by AI and robotics that also reduce personnel actions at sea. DOE also plans to support floating platform designs that are suitable for U.S. manufacturing facilities and further reduce costs. DOE would also begin planning for the first major offshore wind measurement and validation campaign on the West Coast using lidar buoys off the coast of California to develop reliable wind and weather forecasts.
- **\$9 million for social science and socioeconomic research:** DOE plans to launch a new social science and socioeconomic research initiative to understand impacts of wind energy on communities and ocean co-users and provide technical assistance to communities considering offshore wind development. The focus would be on helping communities and ocean co-users understand the impacts of offshore wind development and develop strategies that reduce impacts and increase environmental justice for wind energy development. DOE also plans to offer technical assistance to coastal communities considering offshore wind development to ensure access to fact-based information during planning processes as well as expand collaboration with the NOAA Sea Grant program to support engagement with ocean users regarding offshore wind development.

- **\$5 million for STEM and workforce development:** DOE supports the Collegiate Wind Competition (CWC), which is an annual competition that challenges teams of undergraduate students to develop solutions to complex wind energy projects. In FY 2022, DOE plans to broaden the CWC to include an offshore wind focus. In addition, DOE plans to increase support for research universities to develop offshore wind curriculums, fellowships, and internships with an emphasis on ensuring diversity of the future offshore wind workforce.

### Hydropower Technologies

- **\$10 million for novel water infrastructure sensors:** DOE plans to launch a new research effort to develop novel water infrastructure sensing capabilities to ensure the continued operability of human-made water systems. DOE has found that hydropower combined with water distribution and treatment systems can power behind-the-meter applications for resilience and reliability within water networks or neighboring infrastructure. However, advanced water sensor development and data analytics are necessary to ensure the continued operability of human-made water systems. The scope of this effort includes not only hydropower plants but also water conveyance systems, water treatment, and water storage capabilities.
- **\$3 million for new STEM activities:** DOE plans to launch a new Hydropower Collegiate Competition for undergraduate students, establish a new Hydropower Fellowship program, and compete a new hydropower data analysis prize for graduate students.

### Geothermal Technologies

- **\$28 million for subsurface research, development, and demonstration of enhanced geothermal systems (EGS):** DOE plans to award a third set of near-field EGS demonstration projects through the Wells of Opportunity funding call. The goal is to illustrate that near-field and in-field EGS can be successfully deployed as a result of recent technology advancements and that low permeability/underproductive wells near and in existing hydrothermal fields can be turned into valuable assets using EGS techniques. DOE also plans to fund a second cohort of early career awards in EGS. The EGS STEM Early Career Awards provides seed funding to early career researchers to explore EGS concepts. A major goal of this effort is to increase geothermal literacy and grow advocates for geothermal energy as a preferred energy source. DOE also plans to form a High Temperature Smart Casing Working Group to identify promising research directions to reduce the cost of casing. DOE has found that completing a well – casing and cementing – is responsible for up to half the cost of drilling a geothermal well. DOE is interested in exploring how to lower the cost of casing, create dual purpose casing (for monitoring and wellbore stability), or eliminate the need for casing altogether to dramatically lower the overall costs of geothermal drilling and EGS development. Recommendations from the working group would lead to future funding opportunities.

### Building Technologies

- **\$32 million for buildings-to-grid research and development:** DOE supports flexible building loads research that includes advanced communication platforms and data management systems; advanced sensing, monitoring, fault detection and control capabilities; and interoperability, cybersecurity, user-centered research, and data analytics to maximize zero-carbon energy use and optimize productivity and occupant comfort. In FY 2022, DOE plans to fund up to six new projects focused on integrated scaling of advanced building energy management systems, improved building sector cybersecurity, interoperability, and multi-scale data analytics for grid-interactive efficient buildings to help enable a carbon-free electricity sector. DOE also plans to launch a Building Thermal Energy Storage Consortium centered on materials discovery, characterization, performance evaluation, scaling/manufacturability, and systems integration. The new consortium would issue funding calls for research universities to advance the development, validation, and demonstration of highly sustainable, scalable, and affordable thermal energy storage solutions for building applications,

including low-temperature phase change materials with greater lifetimes and storage capacities, heat exchanger optimization for enhanced rate capability, active control and utilization of the full storage capacity of thermal mass, and advanced HVAC and envelope system designs for ease of integration and reduced costs. DOE also plans to select up to four new Next Generation Connected Communities Projects to support grid interactive efficient buildings.