

United States Air Force Energy S&T Vision

Executive Summary

Energy is essential to all Air Force (AF) missions. This Energy Horizons Science and Technology (S&T) vision provides the Air Force a vector to increase energy supply, reduce demand, and change our culture as articulated in our Air Force Energy Plan. Energy Horizons delineates S&T areas where the Air Force should lead, follow, or watch in order to advance operational readiness, resiliency, and robustness while at the same time supporting national objectives of economic development, environmental stewardship, and supply independence.

Energy Horizons provides the Air Force vision and blueprint for energy S&T spanning the domains of air, space, cyber, and infrastructure. Energy Horizons focuses on S&T in the near (1-5 years), mid (6-10 years), and far (11-15 years) term that hold the most promise to revolutionize AF operations, efficiency, and effectiveness. In partnership with operators and technologists from across the Air Force, the Office of the Chief Scientist engaged experts across government, industry, academia, National Laboratories, and Federally Funded Research and Development Centers to identify the most promising energy S&T.

In the air domain, for example, advanced engines, fuels, structures, and operations were identified that promise to achieve single and double-digit improvements in efficiencies promising increases in loiter/ranges and/or enhanced missions. In the space domain, highly efficient photovoltaics, Hall and electric thrusters, and new battery technologies promise more efficient and resilient space operations and revolutionary new services such as in-space power beaming and on-orbit refueling. In the cyber domain, efficient algorithms and processors and cloud computing promise not only energy savings but also enhanced cyber resiliency. Finally, in infrastructure, advances in renewables, smart grids, and Solar-to-Petrol plants promise to increase energy resilience and independence for both fixed and expeditionary bases.

Across all Air Force domains of operation, Energy Horizons identifies game changing technologies in energy generation, storage and use. Advances in energy generation include ultra-efficient, flexible photovoltaics; small, auto-safing modular nuclear reactors; and efficient and abundant non-food source biofuels. Advances in energy storage (advanced batteries, ultra-capacitors, high power fly wheels, and superconducting magnetic energy storage) promise significant improvements in power and energy density and with increased flexibility in charge/discharge cycles. Finally, nanomaterials (e.g., carbon-carbon nanotubes, memristers), cloud computing, efficient supercomputing, and energy micromonitoring promise multiplicative efficiencies from energy efficient structures and microelectronics, efficient and resilient computing architectures, energy optimized platform designs, and enhanced energy situational awareness and management. While not exhaustive, Energy Horizons provides essential focus.

Extracting value from Energy Horizons will require adoption and sustained effort across the RDT&E, energy, acquisition, and operational communities. May Energy Horizons inspire you to advance the Air Force's assured energy advantage.