

## A Diverse Group Tackling Energy Challenges

One of the most quoted equations in the world is  $E=mc^2$ . Even for those that do not really understand the subtleties of this equation, or what each of the letters represents, most could provide “Who is Albert Einstein?” if the equation appeared on Jeopardy.

E is energy, m is mass and  $c^2$  is the speed of light multiplied by itself. The concept of this equation is that all matter, every particle in the universe can become energy. For practical reactions, we also include a factor x, the completeness of this energy conversion, and write  $E(\text{released})=mxc^2$ . If all the mass can be converted directly to energy, as in the case of antimatter, x is 100%, and the energy released is  $mc^2$ . For chemical reactions, where only a very small portion of the mass is converted, x is very small, and the energy extracted is much less than  $mc^2$ . This conversion completeness is specific to the process, but in general, this concept, that mass can be turned into energy is universal.

Humanity’s ability to harness energy and put it to work, from burning wood to stay warm to running turbines in a hydropower plant to distribute electricity to charge the phone on your wall, can all be measured by mass and conversion. The [Energy and Environmental Sciences Group at MITRE](#) conceptualizes energy problems at this fundamental level but innovates in specific ways to solve practical problems relevant to our federal government sponsors. From energy future analyses that expand upon the fundamental characteristics of matter, to advising the Department of Defense on a particular technology to meet its operational needs, to building tools to model the resiliency of the US energy infrastructure, the group works in a wide-ranging space that is fundamentally related to E, energy.

There is an enormous amount of breadth covered by our small group (11 people). We have experts in propulsion systems, fuel cells, photovoltaics, energy harvesting and power equipment, who have come to MITRE from a diverse set of engineering & science disciplines including electrical engineering, chemical engineering, materials science, mechanical engineering, geography, and physics. Our Bedford, MA, site has an Operational Energy Test Bed facility and in McLean, VA, we have Power & Energy and Bio-Nano laboratories with the capability to fabricate and test batteries and supercapacitors. We leverage [MITRE's](#) 8,000+ employees and their technology and domain expertise to build targeted teams and tackle complex problems for our partners and sponsors.

In our role with [Bridging Innovation](#), we share our technical and business expertise in the energy domain and help connect startups companies with our sponsors. When it comes to the government and our sponsors, these private-sector solutions can be robust sources of innovative technologies that can be applied to the complex challenges we find in government. As examples of the types of engagements our group has been involved with, we have participated in technology analysis for competitive funding, assisted early startups with their pitch decks, mated

technology from different stages with our sponsors' current and forward-looking needs and have helped test/design experiments. We are always open to joint development efforts.

Some of the most recent tools that MITRE's Energy and Environmental Sciences Group have built include:

- Unmanned System Operational Reach Tool
- Installation Energy Analysis
- Dismounted Warfighter Operational Energy Analysis Tool
- Critical Materials and Manufacturing Vulnerabilities Tool
- Data Center Energy Analysis Tool
- Micro-UAV Endurance Estimation Tool
- Directed Energy Weapon Platform Size, Weight, and Power (SWaP) Estimation Tool

In October, the group expanded its focus to work on solutions to reduce the impacts of energy use on the environment. Working on pathways to deploy low-carbon emitting technologies, modeling energy efficient systems, and working on mitigating technologies such as carbon capture are all emerging areas for our team. Please join us in thinking critically about the energy we use as we help our sponsors solve problems for a safer world.

For more information, please contact Dr. Alex Schlichting at [aschlichting@mitre.org](mailto:aschlichting@mitre.org).

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