Directed Energy Weapons

What are Directed Energy Weapons?

Directed energy weapons (DEWs) use focused electromagnetic energy to engage and neutralize enemy threats and assets. These weapons encompass high-energy lasers and high-power electromagnetic systems, including millimeter wave and microwave weapons. Unlike traditional munitions, DEWs can offer benefits such as temporary and reversible effects. They can degrade or disable electronic systems without completely destroying them.

How do DEWs function?

Each type of DEW operates within a specific range of the electromagnetic spectrum. This spectrum includes all forms of light categorized by wavelength. Different wavelengths impart unique properties, affecting penetration capabilities through various materials, such as metal or biological tissue.

How do DEWs function?

- **High Energy Lasers (HEL)** emit a concentrated beam of light, typically in the infrared to visible spectrum. These lasers can be continuous or pulsed, delivering power outputs as low as 1 kilowatt. Their precision allows them to target and melt metal, plastic and other materials.
- **Millimeter Wave Weapons** operate in the 1 to 10-millimeter wavelength range, delivering more than 1 kilowatt of power. They can affect multiple targets simultaneously due to their broader beam.
- **High Power Microwave Weapons** generate microwaves with longer wavelengths than lasers or millimeter waves. They're capable of producing more than100 megawatts of power and can disrupt multiple targets within their larger beam area.

DEWs offer a spectrum of effects from nonlethal to lethal that can be influenced by factors such as exposure time, distance and target area. Moreover, they can be employed in a graduated manner. Nonlethal responses include temporarily disabling electronic systems or preventing access to specific physical areas or systems, while degradation involves reducing the effectiveness of enemy sensors or electronics. Lethal responses entail destroying or severely damaging targets by focusing energy to melt or incapacitate critical components.

DEW Development

Taking DEWs from development to operational deployment presents challenges. Their effectiveness diminishes with increased distance and adverse atmospheric conditions. Operationally, DEWs may have more limited utility than initially believed since wide-beam DEWs can affect both friendly and enemy assets within the area of impact and they may struggle against well-shielded targets or in environments where line-of-sight is obstructed. Additionally, international norms and regulations related to DEWs are in their infancy and do not offer a clear framework by which to mitigate the risks of their use. Furthermore, there are open-ended questions over the ability of existing industrial supply chains to produce DEW capabilities at scale.

Practical Applications

DEWs may offer practical air and surface defense applications. Specifically, they are best oriented to counter slower moving and swarm threats such as drones, rockets, artillery, and mortars by disrupting or destroying their electronic components and guidance systems. DEWs are frequently cited as having potential for missile defense, including against ICBMs, but the technological challenges to such applications are currently

prohibitive. The U.S. Department of Defense claims that DEWs have the potential to counter slower moving missile threats such as anti-ship and land-attack cruise missiles, the basic logic being that DEWs are a lower-cost way to defeat less advanced aerial threats that would allow more expensive interceptors to be saved for the faster and more troublesome ballistic threats that DEWs cannot reliably engage. It's also possible that DEW capabilities could be used against enemy surface boats and autonomous maritime vehicles, as well as adversarial intelligence, surveillance and reconnaissance capabilities.